PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

OCTOBER, 1939

A. PRESCOTT FOLWELL, Editor — VOL. 70. NO. 10 — W. A. HARDENBERGH, Asso. Editor

Contents

EDITORIAL 29

HIGHWAYS:

Citizens Demand More Rural Sidewalks. *By H. H. Sisler* 15
How Snow Removal and Ice Control Pay Dividends 16
Specifications for Constructing Colored Asphalt Traffic Lines 20
Modernizing Old Macadam Pavements 26
"Hot Blade" Expedites Mixed-in-Place Construction 27
Difficult Problems in Snow Removal and Ice Control 36
A 200-year Road Plan 41

SEWERAGE:

Building a Small Sewage Treatment Plant Under Unusual Difficulties. *By Robert M. Lingo* 18
Outside Sludge Heater for Iowa Great Lakes Sewage Plant 24
Sewage Plant Operating Data from Illinois 26
Two Years' Experience in Chemical Treatment of Sewage. *By T. R. Haseltine* 30
The Sewerage Digest 45

WATER SUPPLY:

Iron Bacteria: Classification, Identification and Corrective Measures .. 22
Meter Operating and Maintenance Expense 24
Water Conservation in Honolulu 25
Toledo Water Supply Status 28
The Waterworks Digest 42

DEPARTMENTS:

New Equipment 48, 53, 54
Readers' Service 55
Engineers' Library 58

TIMEWASTERS

The square field with the board fence around it was quite a field all right, but the computations are not so difficult as it sounds. There were 9216 acres in the field and 9216 boards in the fence. This makes a very nice little problem, however. For those who haven't tried it, see page 7, September issue.

A Parlor Game:

Given three pegs, over which 8 rings of alternating color and diminishing size are arranged in the form of a cone, with the largest ring (or course) at the base, what is the least number of moves required to transfer the cone to either of the other pegs. You can move only one ring at a time, and you cannot place a larger ring over a smaller ring. It isn't fair to pull up the peg and put another in its place. We suggest that it is a lot easier to buy the pegs and the rings than it is to work it out mathematically. —*Cleveland Engineering.*

Put Away the Slide Rule:

Another from our Cleveland friends, with thanks to Mr. Derry, employs the well-known phantom division. Here it is:

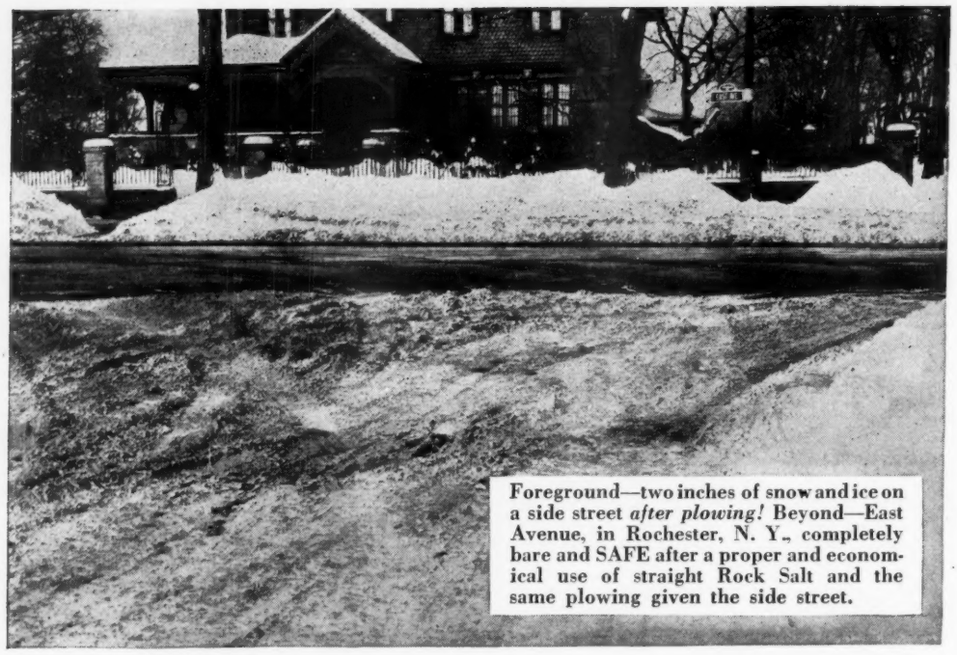
```
 x x x)    x x x x x x x x   (x 7 x x x
           x x x x
             x x x
             x x x
             x x x x
               x x x
                 x x x x
                 x x x x
```

We haven't worked this one out yet, either. Here's hoping we get some correct answers or have time to solve it before next month. *W. A. H.*

SUBSCRIPTION RATES: United States and Possessions, Canada, Mexico and Cuba. $3.00. All other countries. $4.00. Single Copies, 35 cents each.

FOUNDED IN 1896

Published monthly by the PUBLIC WORKS JOURNAL CORPORATION, 310 E. 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising Manager,* ARTHUR K. AKERS, 310 East 45th St., N. Y. *Advertising representatives,* FRED R. JONES, 228 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 326 Bulkley Bldg., Cleveland, Ohio



Foreground—two inches of snow and ice on a side street *after plowing!* Beyond—East Avenue, in Rochester, N. Y., completely bare and SAFE after a proper and economical use of straight Rock Salt and the same plowing given the side street.

MAKE WINTER TRAFFIC REALLY SAFE

BY NEW LOW COST METHODS *WITH* INTERNATIONAL'S ROCK SALT

For years, public officials have sought a low cost way to overcome the icy highway conditions about which the public is so increasingly critical. In recent years, the Research and Engineering Departments of International have been working closely with road and street engineers and maintenance men to develop better ways of meeting the public demand for real winter safety. New methods have been worked out in actual, practical every day use which utilize the great melting power of International's Rock Salt (see table below) to make streets and highways *bare* and therefore safe, *at low cost.*

International will place at the disposal of any street or highway official, the results of its long research, broad experience and practical work in winter pavement safety. Retsof and Detroit brands of Rock Salt are equally economical. Merely write for a copy of the new illustrated folder, "Make Winter Pavements Really Safe." It will tell you about practical methods now used in most northern states. Better still, an International engineer will call, with no obligation, and give you all the facts.

WHY INTERNATIONAL'S ROCK SALT IS SO ECONOMICAL WITH THIS METHOD

Because of its great melting power, Rock Salt is most economical for use in treating stock piles of abrasives to keep them from freezing, and in treating abrasives so that they will be imbedded in ice. For the same reason, Rock Salt used alone is the most economical melting agent to *remove* ice and hard-packed snow. A little does much. In addition, this method saves: cost of abrasives, cost of treating, storing, reloading and applying them; the cost of removing them from roads and streets, sewers and catch basins later; and, since proper use of straight Rock Salt corrects all effects of storms with one treatment, saves the cost of treatments several times a day for several days with abrasives. No wonder public officials say:

"It costs less to keep pavements bare."

POUNDS OF ICE MELTED PER POUND OF CHEMICAL
Maintenance Committee, Highway Research Board Vol. 13

Temperature Deg. F.	Sodium Chloride (Salt)	77-80 percent Flake Calcium Chloride
30°	46.3 lbs. of ice	31.1 lbs. of ice
25°	14.4 lbs. of ice	10.4 lbs. of ice
20°	8.6 lbs. of ice	6.8 lbs. of ice
15°	6.3 lbs. of ice	5.5 lbs. of ice
10°	4.9 lbs. of ice	4.8 lbs. of ice
5°	4.1 lbs. of ice	4.4 lbs. of ice
0°	3.7 lbs. of ice	4.0 lbs. of ice
—6.5°	3.2 lbs. of ice	3.7 lbs. of ice

The greater ice melting power of ROCK SALT
Advantage of Rock Salt in percentages as calculated by International Salt Co., Inc.

Rock Salt melts 48.9% more ice
Rock Salt melts 38.4% more ice
Rock Salt melts 26.4% more ice
Rock Salt melts 14.5% more ice
Rock Salt melts 2.0% more ice
— 6.8% Temperatures at these low levels are seldom long sustained, and make it impractical to use any ice melting
— 7.5% agent due to the large
—13.5% amount required

INTERNATIONAL SALT COMPANY, Inc.
SCRANTON, PA. NEW YORK, N. Y.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55 to 58

PUBLIC WORKS Magazine • • OCTOBER, 1939

Vol. 70. No. 10

Sidewalk forms in place

Pouring the concrete

Citizens Demand More Rural Sidewalks

As reported by

H. H. SISLER

King County Road Engineer

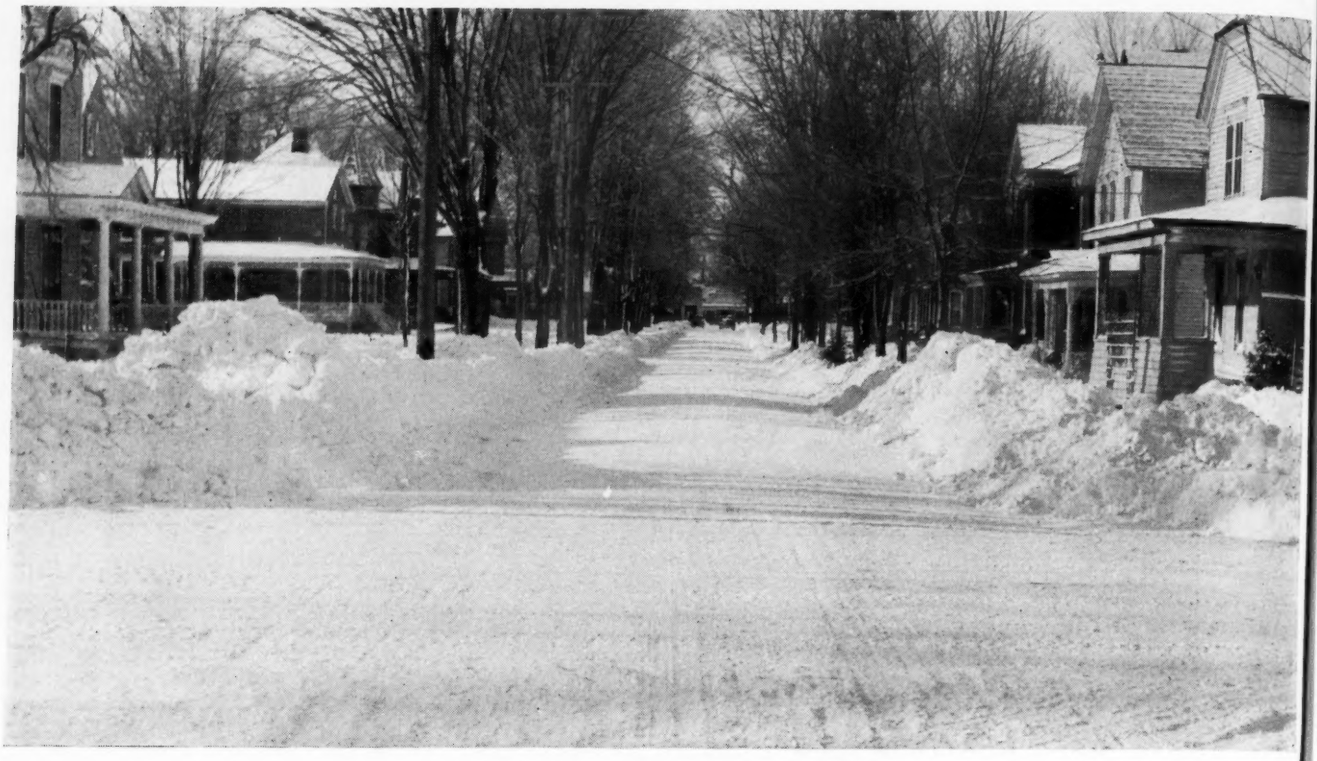
OF 60 traffic deaths in King County, from June 1937 to June 1938, 10 were pedestrian fatalities, and of more than 1,000 non-fatal traffic accidents about 150 involved pedestrians. This is a ratio of one to six, and to decrease such accidents, this county is aggressively pushing sidewalk construction.

Prior to 1937, counties were unable to use gas-tax or road district funds for this purpose, but there were built by abutting property owners approximately 12 miles of sidewalk scattered throughout the county, with widths ranging from 3 to 4 feet. The majority were of concrete 4 inches thick, with a few asphalt and plank walks. Built largely under contract, the supervision of grades was generally furnished by the County Engineer's office. Many property owners hesitated to assume the financial burden to carry on this work and there arose a good deal of pressure on the State Legislature to allow gas tax and road district funds to be used for this purpose, which was done in 1937.

Planned for 1938 was the construction by King County of approximately 20 miles divided equally between the two road districts, only about 12 miles of which were completed that year. This program was undertaken in conjunction with the W. P. A., which supplies the labor, the county furnishing materials, equipment, engineering, and supervision; thus effecting a substantial saving in cost.

King County has adopted a concrete walk 4 feet wide (sufficient to take care of normal pedestrian traffic), 3½ inches thick, one-course concrete of 1:3:5 mix, and by a proper control of sand gradation a very good finish is obtained. For approach entrances to driveways the section deepens to 6 inches. Usually the inside of the walk is placed 2 feet from the property line, on only one side of county right of way, and a modified turnpike section is generally adopted, calling for a shallow drainage ditch between the roadway pavement and the sidewalk. In some instances the W. P. A. has furnished cement, the county supplying sand and gravel, and in others the county has used ready-mixed concrete. With ordinary subgrading and preparation of base, the average construction cost of concrete walks, including W. P. A. labor, is approximately $4,935 per mile. The county's contribution for materials, equipment, and supervision is about $2,600 per mile. With the same county outlay, plant mix asphalt walks come to approximately $3,900 per mile. The county's portion is the same as for concrete walks, because the W. P. A. does not have experienced asphalt crews, so that the County must supply the labor in laying the walks.

Judging from the tremendous number of petitions sent to the Board of County Commissioners, it appears that sidewalk construction has met with very popular response. It has been the policy to honor petitions only on main county roads in congested areas, such as in the vicinity of schools and business districts. Nevertheless, further legislation is needed permitting residents to contribute a portion of the cost, where they are willing to do so, and it is hoped that such a measure will be proposed during the 1939 session.



A cleared street in a northern New York Village

How Snow Removal and I

IN ORDER better to state the many advantages that accrue to a community through prompt and efficient snow removal and ice control, we have asked a number of representative city and county engineers throughout the snow belt to tell us in their own words the benefits of this work. Naturally, there are differences of opinion as to the detail advantages; but all agree that the sum of advantages are most material.

Benefits Experienced by Counties

"There isn't any question in my mind but that snow removal pays. I am basing my opinion on experiences of three years ago when we had an exceptionally large snow fall which tied up traffic on most of our roads for a period of about nine weeks. During that time we were able to keep open a very small percentage of our roads; also the Highway Commission was unable to keep state roads open at all times. There was a marked decrease in business in all towns in the county. Our income from gasoline tax was also reduced materially for these two months. Since we obtain some of our money for highway construction from this source, our construction program the following year was reduced." *C. A. Boeke,* County Engineer, Hardin Co., Iowa.

Duchess Co., N. Y., lies just north of the New York Metropolitan area. Both state highways and county roads are subjected to unusually heavy traffic. Considerable of the long-haul perishable freight, such as fruit and milk, serving New York City passes through this county, and it is imperative that these highways be kept open during the snow removal season so as not to impede or interfere with the ingress or egress of this traffic. This indicates the importance; the relatively small amount expended for snow removal is more than compensated for by the increased gasoline consumption, not to mention the effect it has on business. *Robert F. Knox,* County Superintendent of Highways.

"Better business, more gas tax, health and fire protection" are listed as among the benefits by *Clarence Hoff,* County Highway Commissioner, Vernon Co., Wisc.

Although it is difficult to list all the ways in which snow removal and ice control pay dividends, a few are listed by *Arthur F. Ranney,* County Engineer, Summit Co., O., as follows: Reduction of road accidents; increase in overall efficiency of highway travel, especially as regards time; increases amount of highway travel, which increases the income from the gasoline tax; and puts the community in closer contact with its health, police and fire departments.

"Snow removal is no longer a matter of 'shall we?' remove snow. The public expects and demands the service. The present generation homeward bound from town during a snowstorm is carrying one loaf of bread and one bottle of milk. Regardless of the intensity of the storm they *must,* therefore, get to town tomorrow to replenish their food supply, and if the plow has not passed by the time they are ready to leave for town—helzapoppin. Then, epidemics of disease appear mysteriously during or immediately after a snowstorm of real proportions; and bundles from heaven appear to be scheduled for these same periods." *K. L. Hallenbeck,* Sup't and Manager, Board of Road Commissioners, Washtenaw Co., Mich.

"Actual dividends from snow removal come from

Engineers of a number of cities and counties have told us that, in their localities, they do pay dividends, and how. Also what effect snow removal has on the maintenance of their roads, This article is a symposium of their conclusions.

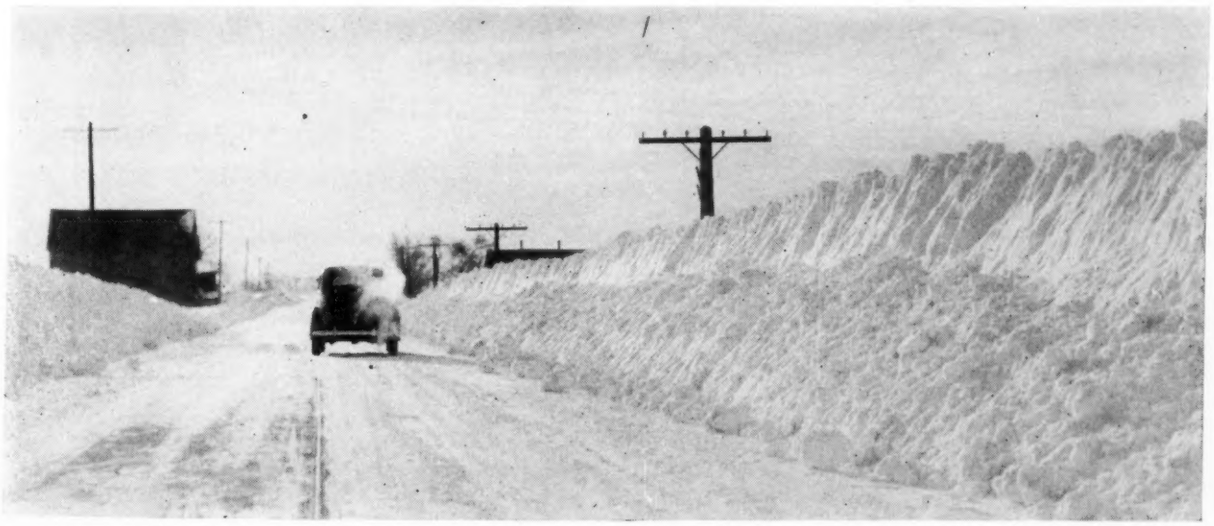
nd Ice Control Pay Dividends

free use of the highways for vehicles, increased revenues from gasoline sales and consumption and positive health and fire protection." *W. W. Chadsey,* County Superintendent of Highways, Schenectady Co., N. Y. "No question but that snow removal is better for business and fire and health protection." *George W. Buck,* Roadmaster, Multnomah Co., Ore. ". . . The removal of snow and keeping highways open for business and travel is essential to the life of a modern community." *Walter E. Rosengarten,* Township Engineer, Lower Merion Township, Montgomery Co., Pa.

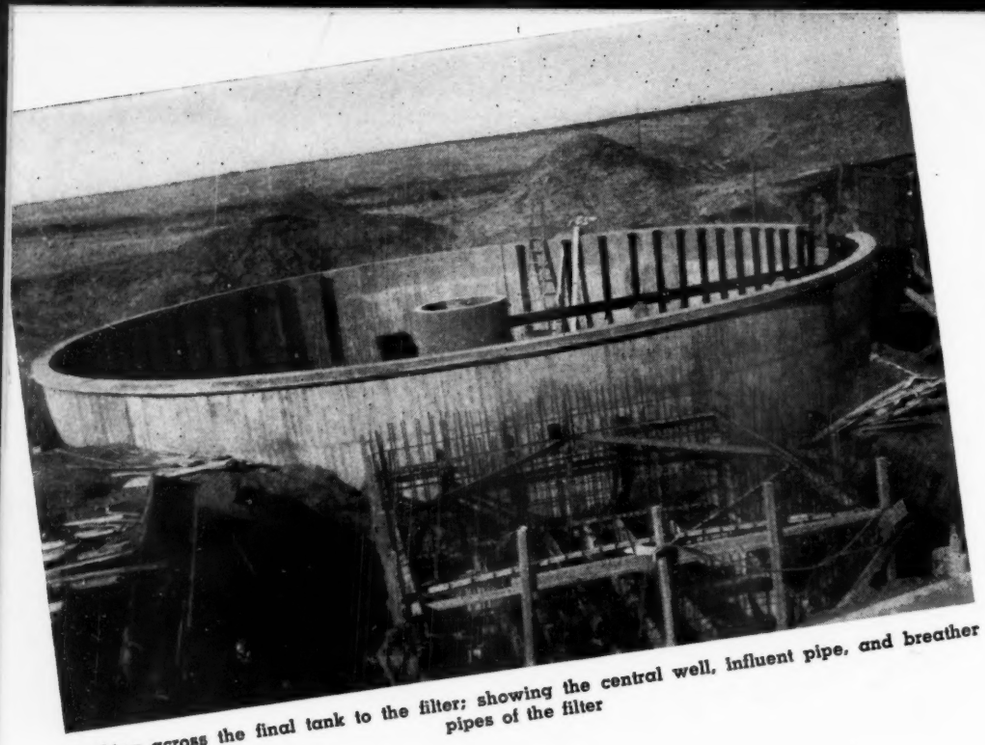
The Benefits Derived by Cities

Auburn, N. Y. *J. Francis Poole,* St. Sup't, says: "A thorough job pays dividends. If the streets are free from snow, business can go on as usual. The fire department is not hampered, deliveries can be made

(Continued on page 35)



A plowed road in the town of Champion



Looking across the final tank to the filter; showing the central well, influent pipe, and breather pipes of the filter

Building a S Plant U

BY ROBERT M. LINGO

Resident Engineer for A. W. Hefling, Consulting Engineer

THROUGHOUT that part of the country known as the "dust bowl" there many towns with about the same population and almost identical general makeup—1,000 to 3,000 population, with few manufacturing concerns, no industrial waste, and little prospect of future growth. It is therefore only natural that some one form of sewage disposal would fit most of them, and there has been general adoption of Imhoff tanks, trickling filters and re-settling tank.

Such a plant has recently been built by Wilson, Kans. Its population is about 1100 and the plant is designed to care for a maximum population of 1500. In designing the plant the following conditions were considered:

1) Because the size would not permit the expense of a full-time operator, the plant should be self-operating.

2) No mechanical equipment not absolutely necessary was used because electric power was not available and other engine power would require an operator.

3) The head consumed must be kept at the absolute minimum.

4) Money for construction was limited; although PWA paid 45% of the cost, the project included the entire sewer system.

The plant operates entirely by gravity except that a pump is used to remove the sludge from the final tank to the raw sewage. This is a 40 gpm pump with a 1½ hp air-cooled gasoline engine that will be operated only a couple of hours every six months.

While the plant itself is not unusual, some features of its construction were. Operation by gravity meant that the plant must be built almost entirely under ground. The bottom of the Imhoff tank had to be 28 ft. below ground surface, in difficult excavation. At less than 3 ft. depth we encountered sand—sharp, clean, well graded, excellent for concrete but difficult to excavate without making a hole very wide at the top. At 18 ft. we struck water, and sand and water combined make a very poor bank. As the entire plant was to cost only $23,000, use of large, expensive machinery or complete shoring seemed out of the question. The unstable sand would not support a clam shell, and using a drag line and allowing the banks to cave, the top of the hole was already three times as wide as desired when we struck water, and there seemed to be no hope but to use sheet piling. This was made of such dimensions that the forms for the concrete would fit inside the walls, which were built up out of 3 x 12 lumber, 2 x 12 lumber being used for sheeting.

Four or five feet above final bottom the piling struck clay so stiff that it could not be driven into it. Ground water seeped under the piling, and the excavation was stepped in, forming a shelf on top of the clay, on which the water was led to a sump, from which it was removed by a 3″ pump, which was in continuous operation for six weeks. In one way the ground water was a help, for this work was done during cold weather and the water froze in the banks and helped to hold the sand from sliding. This was especially fortunate as this excavation was only ten feet from the filter, which had already been built, and extended 18 ft. below the footing of it. The filter being on the south side of the hole, the shade formed kept the bank from thawing out for many days. The dirt from this and the other excavations was used to build a dike around the entire plant, which not only protected it from high water but also made a wind break which helped prevent tumble weeds etc. from entering the plant and set off the general appearance.

The clay in the bottom of the excavation was so cut as to act as part of the outside forms for the concrete. Higher up, in the sand, we lost some of the forms, which seemed to be unavoidable. In pouring the bottom concrete, wires were left sticking above the surface and used to tie down the inside forms for the hopper bottom. The completed tank was 22 x 32 ft. inside at the top and for 17 ft. down, tapering to 6 x 16 ft. at the bottom, 15½ ft. lower. The 8″ c. i. pipe siphons for sludge removal were put in place before the concrete was poured; also an 8″ pipe with T openings at the top to act as scum remover. The entire inside of the tank below water level was given two coats of waterproofing.

The filter is 60 ft. diameter with crushed rock 8 ft. deep, the drains being half-round 6″ tile raised ¾ in.

Small Sewage Treatment Under Unusual Conditions

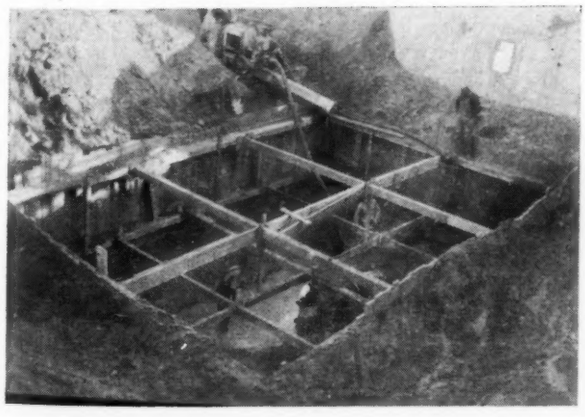
How Wilson, Kans., built an Imhoff tank, sprinkling filter and sludge beds for $23,000, although excavation for the first was through 28 ft. of running sand and tough clay. (Cold weather helped by freezing the wet sand.) The several structures are in contact so that no piping was necessary.

above the floor, which is in the form of a series of hills and valleys. One end of each tile line opens into a central collection channel, the other end—near the outer wall of the filter—meets a vertical cast iron soil pipe, which admits air to the bottom of the filter, can be used for flushing the drains if they should become choked.

The distributor is supported by a central pier 2 ft. diameter, around which is a wall forming an annular well 2 ft. wide into which the drainage system discharges and which affords additional ventilation. The distributor arms are set 23″ above the surface of the filter medium—about a foot more than common practice—which will permit adding 12″ more of stone and so increasing the capacity of the filter if this should be desired in the future, and much better distribution seemed to be obtained. The discharge level of the water in the dosing tanks is only 18″ above the center of the distributor arms.

The outside wall of the filter stands about 2½ ft. above the level of medium, providing a windbreak for the distributor jets. During the final inspection of the plant a very high wind was blowing but no liquid was noticed to blow out of the filter and the operation of the distributor was unaffected. Tumbleweeds, which are very numerous in this section of the country, would cause trouble by blowing onto the filter, but this is prevented by a fence surrounding the entire plant, which also adds materially to its general appearance.

Close-up of the collection channel and underdrain system of the filter



Excavating the Imhoff tank, showing sheet piling used to hold back sand

The hopper-bottom final settling tank and the sludge bed present no unusual features of design or construction. One noticeable feature of the plant is its compactness. This saved in piping, in lost head and in concrete for walls, make for the economy desired. The sludge bed and Imhoff tank have a wall in common. The dosing tank is formed by using walls of the Imhoff tank and the filter. In the entire plant the only piping used for the normal flow of sewage is that from the dosing tank to the center of the filter.

The plant was designed by A. W. Hefling of Hutchinson, Kans., for whom the author served as resident engineer on this job.

Specifications for Constructing Colored As

Colored asphalts and their use for road markings have aroused much interest. Specifications for materials and equipment and detailed directions for construction are presented herewith.

A SPECIAL asphalt has been developed which has a relatively light color so that if a mix is made using it and various pigments, the amount of pigment needed is so small that the asphaltic quality of the mixture is not lowered. Stripes may be of yellow or red, or of aluminum colored material. Where laws require that the stripe be white, the aluminum color can be used, this having been interpreted by governing bodies as meeting the white color requirement. However, the yellow or red materials are cheaper and just as satisfactory and effective in most cases.

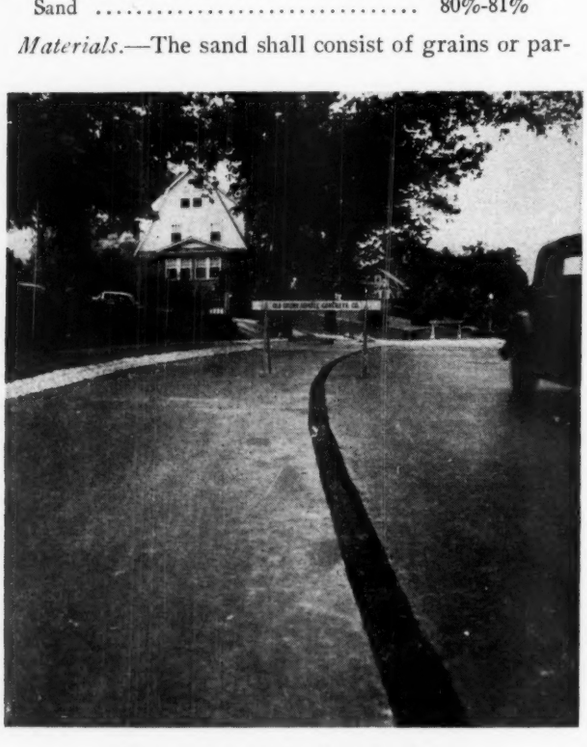
The following detail specifications and directions call for the use of "Shell Albino Asphalt or equal" but we do not, at present, know of any other source for this colored light asphalt.

Description.—Colored Traffic Lane Markers shall consist of sand and pigment mixed with "Albino." It shall be placed in a clean cut trench or in the forms as called for on the plans. The width and depth of the Traffic Lane Marker shall be as shown on the plans.

The material shall be mixed in the following proportions by weight:

Pigment	10%
Albino or equal	9%-10%
Sand	80%-81%

Materials.—The sand shall consist of grains or particles of quartz or other hard and durable rocks, the surfaces of which are sharp and clean.



The trench is cut for the colored line

Placing the line

The sand shall be well graded from coarse to fine and when tested by means of laboratory screens and sieves shall meet the following requirements:

Passing ¼-inch screen	100%
Passing 20 mesh sieve	30% to 75%
Passing 50 mesh sieve not more than	28%
Passing 100 mesh sieve not more than	8%
Passing 200 mesh sieve not more than	4%

The pigment shall be, if yellow, that manufactured by the Krebs Pigment and Color Corp. #Y-405-D, and if for red stripes, #YE-421-D or equal.

The bituminous material shall be Albino or equal susceptible of holding pigments in the proportions set out below without bleeding, and shall be of such a nature that, when combined with aggregate and pigment or other coloring agent, the mixture shall assume the color required, and shall contain no asphaltenes.

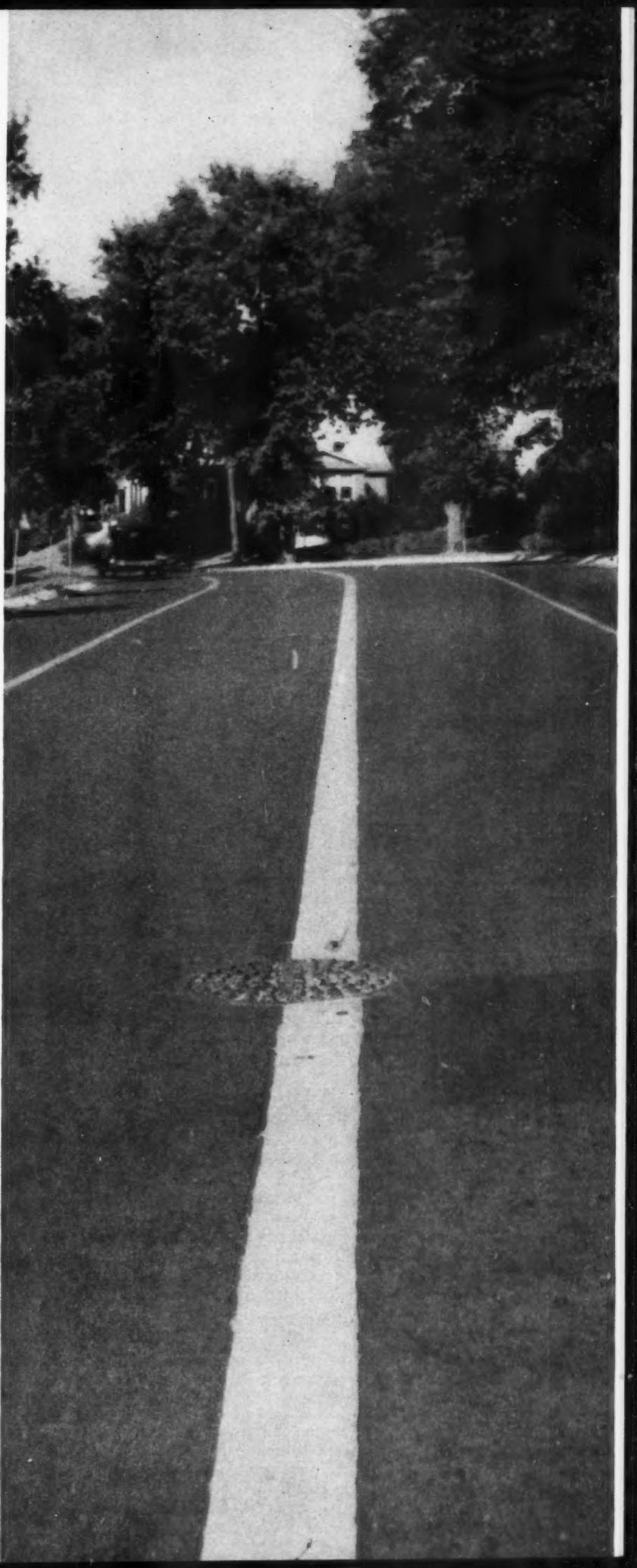
The specifications of Albino or equal are as follows:

1. Specific gravity 25°C (77°F)	Min. 1.01	
2. Flash point open cup	Min. 500°F	
3. Penetration at 25°C (77°F)	Min. 50	Max. 70
4. Loss at 163°C (325°F) 5 hours.		Max. 1.0
5. Ductility 25°C (77°F)	Min. 110	
6. Total bitumen soluble in carbon disulphide	Min. 99.5	
7. The color of a mixture of 99.9% benzol with .1% "Albino" shall be darker than 2.5 NPA when tested in accordance with ASTM method D155-34-T.		

Mixing Method.—The sand shall be heated to at least 225° F and under no circumstances over 250° F in an approved manner, and the pigment added and the two mixed until a homogeneous mix is obtained. The Albino shall be heated to 200°-250° F in an approved clean kettle, and the proper amount added

Asphalt Traffic Lines

These specifications and directions have been furnished by J. S. Sawyer, Asphalt Dept., Shell Oil Co.



Complete job at right

to the mixed sand and pigment, and then mixed until the whole mass is of a uniform color. The mixing shall be done in a clean pug mill, plaster mixer, or other approved machine, so located that the temperature of the mix will not fall below 205°F when placing the material in the road.

The proportions of the different ingredients required to prepare the traffic lane marker shall be determined by weight. The traffic lane marker must not vary in composition more than the specified limits given, and the exact amount of sand, pigment and Albino to use between the limits defined herein shall be determined by the engineer or his representative.

Construction Methods.—A trench true to the lines, width, and depth as shown on the plans shall be cut by a jackhammer or other approved method that will give a true edge to the side of the trench, and the trench cleaned to the depth shown on the plan. In the event that any edge is broken during the cutting, it shall be immediately replaced with fresh material and allowed to harden before the traffic lane marker mixture is laid.

The material may be spread by a simple spreader box, by two sheets of metal held upright within the trench and slid along as the material is placed or otherwise. The amount of loose material necessary to compress to the true lines as shown on the plans shall be determined by the engineer. Great care shall be taken that small particles of the mixture that may fall on the finished pavement are immediately removed.

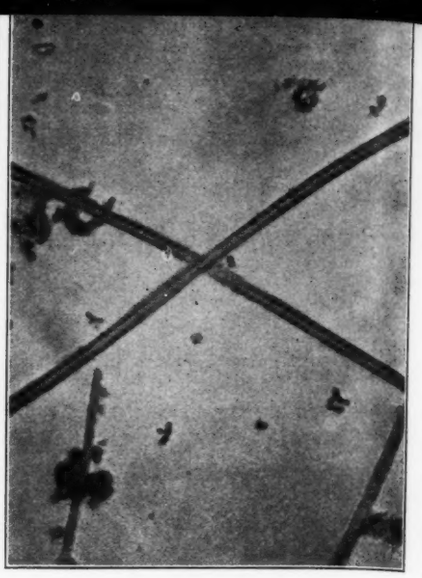
After placing the material, it shall be immediately tamped with hot tamps beginning at the edges and working toward the center of the stripe. As soon as the material has cooled sufficiently to bear the weight of the roller, it shall be thoroughly rolled. Any depressions or high spots shall be immediately corrected by the adding or subtracting of material to the true grade. Any material that has chilled too much to be readily workable shall be immediately removed from the job, and any faulty material that shows up shall be immediately removed and replaced with new material.

Care will be taken that the edges of the line marker and pavement are closely sealed and are a true line.

Where the marker is to be aluminum colored the specifications are the same except that the words "aluminum paste" are substituted for "pigment" wherever that word occurs; that the proportions of aluminum paste and of sand are "2½%-3½%" and "85%-87½%" respectively; that the sand is heated to between 250° and 300°, and the Albino to between 250° and 275°. Also for description of the pigment, substitute the following:

The aluminum paste shall be of a 400 mesh, with a tolerance of 1%, as manufactured by the Aluminum Company of America, standard lining paste #1572.

Photomicrograph of Crenothrix threads from city water, Madison, Wisc., magnified 450 times



Leptothrix magnified 1,400 times

Iron Bacteria: Classification, Identification an

When iron is present in the water (about 2 p.p.m.) iron bacteria may grow, causing serious trouble. This article gives data on classification, methods of identification and treatment.

IRON in some form is found in most natural ground waters, iron compounds in the soil being dissolved by the action of acids present in surface and ground waters. Carbon dioxide or carbonic acid with various other organic and inorganic acids all enter into the chemistry of rock dissolution, carbon dioxide being perhaps the most important. Although this is a relatively weak acid, its abundance and continuous presence cause most metals in the soil to be taken into solution in the form of carbonates.

Iron carbonates are retained in solution in water so long as an excess of carbon dioxide is present, but ultimately the iron is generally precipitated by either chemical or biological processes into any one of the following forms: ferric hydroxide, ferrous carbonate, ferrous or ferric silicate, iron phosphate, ferric sulphate, ferrous sulphide, iron disulphide. Under ordinary conditions ground waters become saturated with oxygen soon after reaching the surface and the iron carried in solution is changed to insoluble ferric hydroxide and deposited.

Neither ferrous nor ferric salts, as found in solution in ground water, are harmful to the human body, which requires about 5 mg of iron a day—an amount that is almost impossible to obtain from drinking water alone. The U. S. Treasury standard of 0.3 ppm is really low from the bio-chemical standpoint. But iron in excess of these limits may cause considerable trouble such as pronounced taste and odor, staining and discoloring plumbing fixtures and laundry, clogging of pipes and meters.

Most iron troubles can be traced to one or more of three causes: 1) An excess of iron from the source; 2) the chemical nature of the water, causing iron deposits and corrosion troubles; 3) iron bacteria. The first is probably the most prevalent, the third the least so. The causes and treatment for the first two are well known, and this article is confined to discussion of iron bacteria.

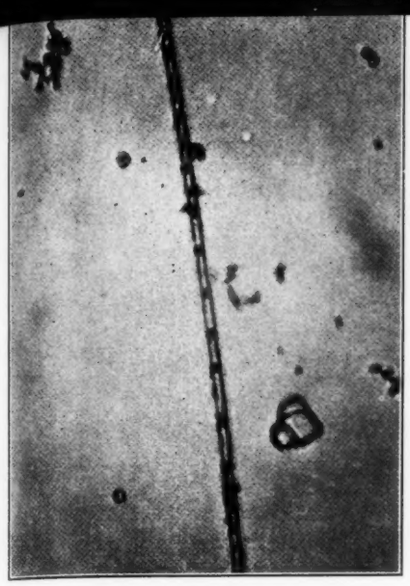
Classification of Iron Bacteria

The title "iron bacteria" is used to cover all organisms capable of withdrawing iron from the water in which they live and depositing it in the form of ferric hydrate on or in their mucilaginous surfaces. According to E. C. Harder, of the U. S. Geological Survey, it has been known since 1836 that certain bacteria had the power of withdrawing iron from solution and causing its precipitation as ferric hydroxide. These iron-depositing bacteria can be classed in three groups from the standpoint of origin:

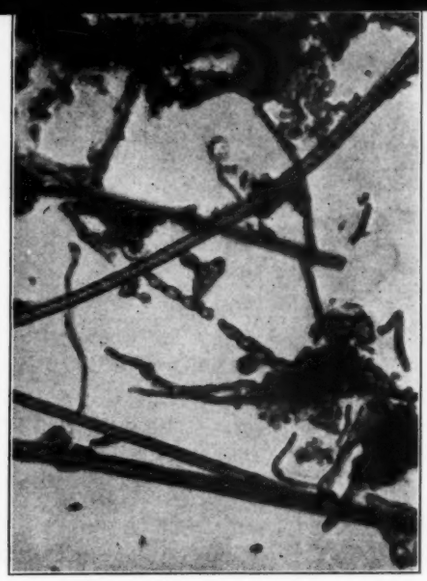
1. Those that precipitate ferric hydroxide from solutions of ferrous bicarbonate, using the carbon dioxide set free and the available energy of the reaction for their life processes.
2. Those that do not require ferrous bicarbonate for their vital processes but that cause the deposition of ferric hydroxide when either inorganic or organic salts are present.
3. Those that attack iron salts of organic acids, using the organic acid radicle as food and leaving ferric hydroxide, or basic salts that gradually change to ferric hydroxide.

The iron-forming bacteria commonly found in ground waters have also been classified according to their physical forms into two groups; higher bacteria such as Crenothrix, Gallionella, Spirophyllum, Leptothrix and Clonothrix; and lower forms of iron-depositing bacteria, such as Siderocapsa and Bacillus M.7.

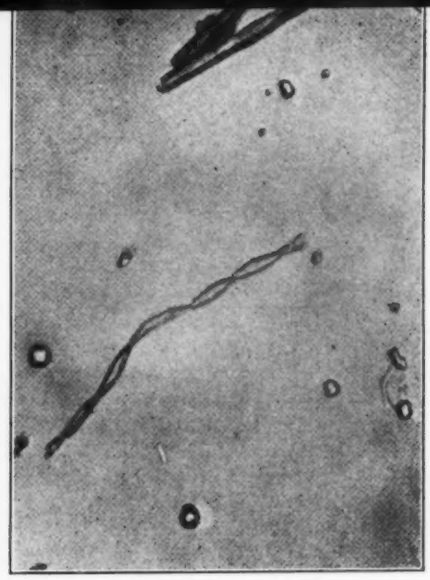
The higher bacteria are distinguished from the lower bacteria by their form structure and method of reproduction; they are generally recognized by their filamentous or thread-like form while the lower bacteria occur in spherical, spiral or rod-shaped forms. The higher bacteria reproduce by the formation of conidia



Gallionella magnified 1,400 times



Iron bacteria in Des Moines gallery water



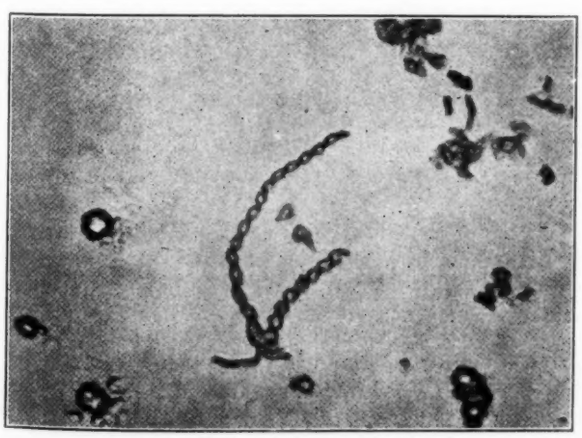
Spirophyllum magnified 1,400 times

ion and Corrective Measures

or swarm spores and the lower bacteria by simple cell division.

Opinions differ as to the method whereby iron is taken from solution. Some hold that the withdrawal of iron and its deposition are successive stages in the life of the organism, while others hold to the theory that the process is chemical and not essential to the life of the organisms. We are concerned more with the effects of the organisms or bacteria as found in water supplies than their mode of living. Crenothrix of the filamentous group is by far the best known of the iron bacteria and is most commonly found at the bottom of wells and in city water pipes. Less than 2 ppm of iron in water will support the growth of Crenothrix. It grows as a filament, the separate cells being in a row, end to end in a sheath. They are readily seen under a microscope and in the earlier stages of development are colorless, turning to brown or black in the later stages of maturity.

Toward the upper end of the filament or thread the individual cells divide to form a large number of small, spherical cells. These are the condidia or spores, which leave the parent sheath to form new threads. Clonothrix and Cladothrix are closely related to Crenothrix and vary principally in their form and method of reproduction.



Cladothrix magnified 1,400 times

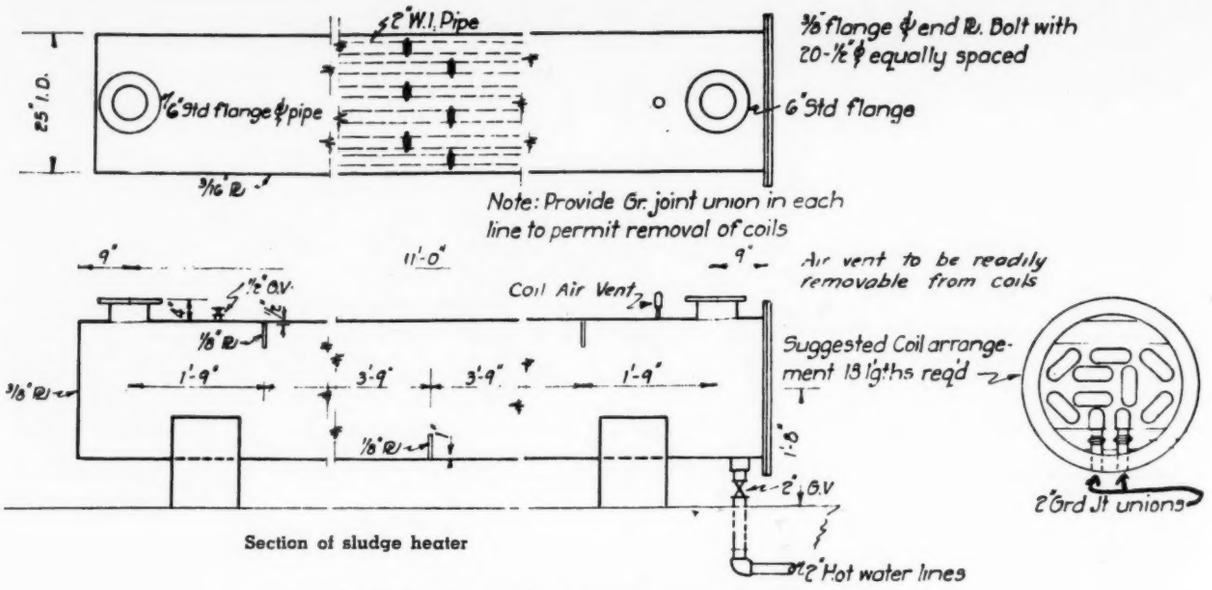
Leptothrix, the next most important member of the filamentous group, is found abundantly in iron water springs where it appears as a soft, fluffy mass attached to the sides and bottom of the basins. It is sometimes found in mines or tunnels where iron-bearing water is found in the rock fissures. It is not as troublesome as Crenothrix as it does not reproduce as readily, and therefore is less capable of causing conditions as bad as those found where Crenothrix is present. Under a microscope, Leptothrix is a thread form usually free but sometimes attached at one end. The threads consist of a sheath with rod-shaped cells lying end to end inside. In the early stages of development Leptothrix is colorless, gradually changing to a yellowish brown as the thread becomes coated with ferric hydroxide.

Gallionella, a third form of the filamentous group, is not so common, being found in some natural waters and in mines. This species is so closely related to Spirophyllum that it is difficult to tell them apart in the adult, iron-encrusted form. Gallionella threads can be recognized by their tendency to wrap around each other (like twisting two pieces of string).

Spirophyllum appears, according to Ellis, to be the most widespread of the iron bacteria. It occurs abundantly in ferriferous surface waters as well as in underground waters. It is generally found with some of the other forms of iron bacteria but frequently occurs where no other filamentous bacteria are found. With Leptothrix it is found in springs and clear stream waters; with Crenothrix and Gallionella in city water systems; and with Gallionella and Leptothrix in mine waters. Spirophyllum is characterized by an absence of cell structure and by a flat band-like appearance, the band being twisted around its long axis.

The lower forms of iron bacteria are divided into two groups—those of the bacillus type that precipitate ferric hydroxide or basic ferric salts, and those that precipitate ferrous sulphide. The former are found in practically all soils and natural waters. They do not require iron in solution for their development but

(Continued on page 38)



Detail of outside sludge heater for Iowa Great Lakes plant

Outside Sludge Heater for the Iowa Great Lakes Sewage Works

In an article describing these work in the August issue of PUBLIC WORKS appeared the following:

Unsatisfactory experience with the usual method of heating digesters, that is, a pipe spiral fastened to the inside wall of the tank, led to the development of a sludge heater located in the control room. This unit utilizes a 500 gpm Yeomans sludge circulating pump forcing sludge through a cylindrical shell and around a pipe coil containing circulating hot water. Sludge or supernatant liquid may be drawn off or returned to the digester at any of five different levels, thus insuring that the completely digested sludge will remain undisturbed at the bottom of the digester. There is also a three-point supernatant liquid drawoff discharging to the sludge storage tank.

We have received requests for further information about this method of heating digesting sludge, and at our request Mr. Swisher has sent us a copy of the plan of sludge heater, and the following further information:

"The design of a unit of this type is based primarily upon the coefficient of heat transmission selected. This may be as high as 60-70 B.T.U.'s per square foot of coil area per degree difference in sludge temperature and heating water temperature. It is our belief that the latter should not exceed 120° F. in order to prevent caking of sludge around the coils and consequent lowering of the transmission coefficient.

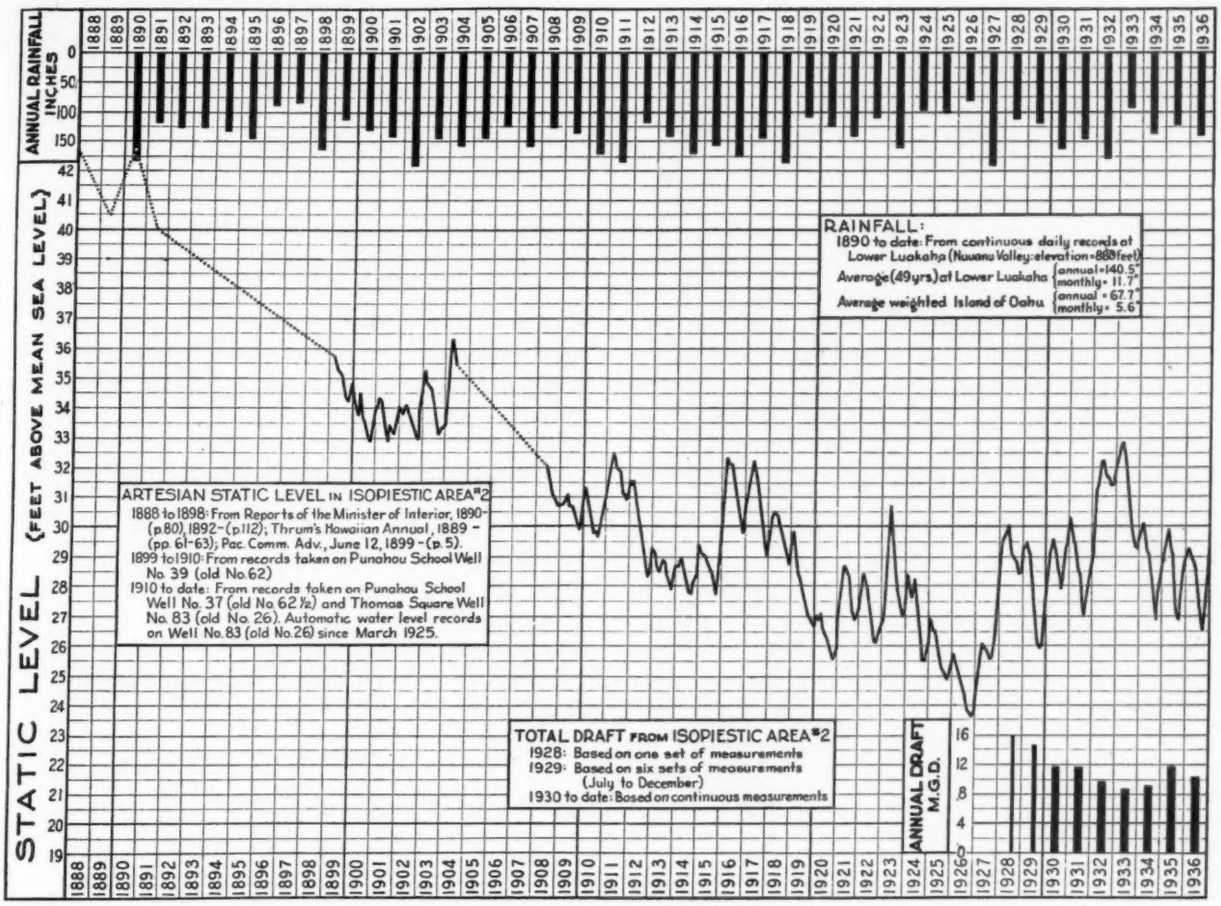
"The sludge drawoff from the digester is a simple arrangement of valves which permits sludge to be withdrawn or returned to the digester at a number of points. Briefly, the branch of a tee is connected to the digester; one end of the run is connected to the pump suction through a gate valve; the other end of the run is connected through a valve to the discharge end of the sludge heater. By opening one valve or the other the direction of flow through the branch line may be reversed and sludge withdrawn or returned to the digester."

Meter Operating and Maintenance Expense

Expenditures incurred in connection with the maintenance of meters in service are divided into four principal accounts by the American Water Works and Electric Co. which operates some 75 plants. These four accounts are: 1. Removing and resetting meters, which covers all expenditures for removing and resetting meter on premises of the customer in the periodical inspection of meters, as well as the cost in connection with discontinuance and resumption of service. 2. Meter and fittings, which includes cost of keeping meter shop records, shop rentals, etc. 3. Relocation of meters, which covers all costs for material and labor in connection with relocation or changing position of meters or meter boxes. 4. Maintenance of meters, which covers all expendiures in connection with repairing meters and boxes, including the costs of testing, removing and resetting when done in connection with maintenance.

During the year 1938, the company had an average of 568,151 meters in service. During the year, 19% of these, or 108,322, were tested. The cost (see classifications given above) of removing and resetting were $71,165, for meter and fitting expense $36,612, for relocation $8,377, and for meter maintenance $178,106. The total cost amounted to $294,260 for the 568,151 meters in service, an average cost of 52 cents per meter.

Local conditions greatly influence costs; for instance, in a resort town, seasonal influences will greatly increase the cost. Among the 75 plants listed, total average costs per meter in service varied from 7 cents to $2.18; but 31 of them showed costs within the 40 to 70-cent range.


ANNUAL RAINFALL INCHES
STATIC LEVEL (FEET ABOVE MEAN SEA LEVEL)
ANNUAL DRAFT M.G.D.
RAINFALL:
1890 to date: From continuous daily records at Lower Luakaha (Nuuanu Valley; elevation = 880 feet).
Average (49 yrs) at Lower Luakaha {annual = 140.5" monthly = 11.7"
Average weighted Island of Oahu {annual = 67.7" monthly = 5.6"
ARTESIAN STATIC LEVEL IN ISOPIESTIC AREA #2
1888 to 1898: From Reports of the Minister of Interior, 1890- (p. 80), 1892- (p. 112); Thrum's Hawaiian Annual, 1889 - (pp. 61-63); Pac. Comm. Adv., June 12, 1899 - (p. 5).
1899 to 1910: From records taken on Punahou School Well No. 39 (old No. 62)
1910 to date: From records taken on Punahou School Well No. 37 (old No. 62 1/2) and Thomas Square Well No. 83 (old No. 26). Automatic water level records on Well No. 83 (old No. 26) since March 1925.
TOTAL DRAFT FROM ISOPIESTIC AREA #2
1928: Based on one set of measurements
1929: Based on six sets of measurements (July to December)
1930 to date: Based on continuous measurements

Annual rainfall, artesian static level and total draft, isopiestic area No. 2. Records for 49 years

Water Conservation in Honolulu

HONOLULU, Hawaii, has a population of 155,000, estimated as of Dec. 31, 1938; is growing rapidly, and it is estimated that by 1960 the population will reach 265,000. As is the case with most well populated islands, the water supply is an important consideration. The mean of the 49-year annual rainfall records is 140.49 in. a year, varying from a minimum of 83.49 in 1926 to 191. 11 in 1902. With an area of 4,030 sq. mi. this gives about 30 million acre-feet of rainfall to supply both agricultural and industrial uses and the demands of the city of Honolulu. Much of the rainfall is evaporated and used by the lush vegetation, and much is absorbed on the water sheds to maintain an underground supply. About 90 percent of the city's supply is drawn by wells from five artisian areas underlying the city, which areas have an estimated capacity of 35 to 40 mgd. The remaining 10 percent comes from springs and tunnels in valleys in the mountains back of the city.

In 1925 water was supplied to the city by what was described as "antiquated equipment, by no means a system but an unplanned patchwork of unrelated units." That year the Legislature of the Territory appointed the Honolulu Sewer and Water Commission to meet the public health emergency presented by the water supply condition. (Later this was succeeded by a Board of Water Supply.) The quality of the water was excellent, but the consumption in the city was over 300 gallons per capita, and the keynote of the policy of Commission and Board has been "Conserve water." It is painted on their vehicles, printed on their letter heads and bills, emphasized in every way possible.

Conservation was made much more difficult by the fact that 40% of the water drawn from the artesian reservoirs came through 73 privately owned wells, over which the city had no legal control. Water used from the 25 city-owned wells was metered and, after a campaign of education, that from the privately owned wells also. By 1938 the consumption had been reduced to an average of 229 gpd per capita (approximately a third used for irrigation).

Another method of conservation is to eliminate leakage from artesian wells. Some of these date from 1880 and the old casings are leaking artesian water into the upper strata. There are 28 of these no longer used—some covered up and forgotten. These are being sealed to prevent this loss.

By metering, urging conservation and sealing leaking wells, the draught on the artesian supply has been so reduced that the static water levels have risen from 5.95 ft. to 11.54 ft. in the five different artesian areas since 1926. They are still about 5 ft. lower than they were when the first wells were sunk; but the rise has removed the threat of salt pollution of the artesian sup-

Sealing the pioneer artesian well, sunk in 1880

ply, which it was believed would have occurred had the water level been lowered 5 ft. more.

Leaking wells are known to be accountable for considerable loss of the artesian supply. Last year the Water Board sealed eight wells which were leaking about 1.5 mgd. Well sealing will be continued, as funds become available, until all leaking or unused wells have been sealed. It also is proposed to recharge the artesian areas by turning surface water onto the percolation areas.

Well sealing was done last year by contract for rental of equipment and furnishing skilled and semi-skilled labor, the Board of Water Supply directing all operations. Under this contract eight wells were sealed. Fourteen more are under consideration for sealing, 10 of them no longer used, the others leaking; 10 privately owned. As an illustration of the sealing, description of work at the Goo Kim Well No. 28 may be given. This well was drilled in 1881, 428 ft. deep with 412 ft. of 5⅝ in. casing. The location of the well was known only approximately, and was determined by use of a "magnetometer." On examination it was found that the static head was +2.09—26.3 ft. below normal. Vertical velocity tests showed leakages at the 33, 45, 135, 231 and 370 ft. depths, the total leakage was estimated at 0.4 mgd. As material was continually falling in, the well was cased off with 4″ pipe to the 83.4 ft. depth. One hundred bags of standard cement were tremied in but sounding showed that the high velocity had carried the cement away. Four hundred and fifty pounds of iron-filings were poured in, filling 18.6 feet. Then 125 bags of quick-setting cement were tremied in, forming a cement plug of 193.3 feet; the remainder of the hole being filled with soil. The total leakage conserved is estimated at 0.4 million gallons per day. The total cost of sealing was $984.43, exclusive of supervision, which was $294.11.

Well No. 93 had a static head 9.4 ft. above ground surface but 16.2 ft. below normal. It was 1010 ft. deep, with 900 ft. of 10″ casing. Vertical velocity tests showed a major leak at —56 ft., which was cased off with 8″ pipe with a 10″ grummet for a lead-off pipe. Then 11,500 lbs. of iron filings were poured in, filling 50.4 ft., and 200 bags of quick-setting cement were tremied in two pours, filling to the 732.8 ft. depth and forming a cement seal of 227.3 ft., the remainder of the hole being filled with soil. Estimated leakage conserved, 0.9 mgd. Total cost, $1489.

Sewage Plant Operating Data

"The Digester," edited by W. H. Wisely for the Illinois Division of Sanitary Engineering, always contains a great deal of useful information and interesting news; the latter especially being told with just enough humor to keep you reading from cover to cover. Some of the items in the August issue will interest many of our readers.

GILLESPIE: Operator Wess Sneeringer was recently initiated into the S.O.W.H.E.S.S. (Society of Operators Who Have Experienced Saturation in Sewage)*. Sneeringer opines that "if anybody doubts that it is a mean trick on the fish to dump raw sewage into a stream, just tell them to fall in an Imhoff tank!" Thanks Wess, we'll take your word for it.

EDWARDSVILLE, HIGHLAND: Finding themselves handicapped by lack of sludge drying area during that early Spring critical period, Harry Hanser and Harold Gnaegy, respectively, were glad to try alum treatment of the sludge as drawn to speed drying. At Edwardsville, one pound of alum to 85 gallons of sludge caused a 12-inch draw to shrink to a 5-inch depth in 18 hours. The sludge was removed in two weeks. At Highland, similar treatment made it possible for an 8-inch draw to be removed from the beds in just one week!

The alum seems to separate the moisture from the sludge and to cause the solids to float. This allows a large part of the water content to drain through the sand very quickly. The demonstration at the Edwardsville sectional meeting was so effective that Shorty Spiess at Litchfield and Maynard Long at Hillsboro could hardly wait to get home to give the idea a trial!†

HINSDALE: Operators Greek and White have nothing against soft water but they don't have much use for the sludge that reaches their plant from the city water works where the lime-soda softening process is used. The results of a highly practical study of the effect of this sludge on the sewage treatment works were reported at the Arlington Heights sectional meeting by Ed Greek. His conclusions follow:

1. Lime sludge should be released to the sewer at a low rate of discharge.

2. When concentration of lime in sewage was about 350 p.p.m., the efficiency of suspended matter removal in the Imhoff tanks increased from 64% to 82%.

3. Lime sludge increases pH of sewage (which is beneficial as this freshens the sewage and retards odor production).

4. About twice as much digestion volume is required in Imhoff tanks when lime sludge is to be taken as is needed for domestic sewage only.

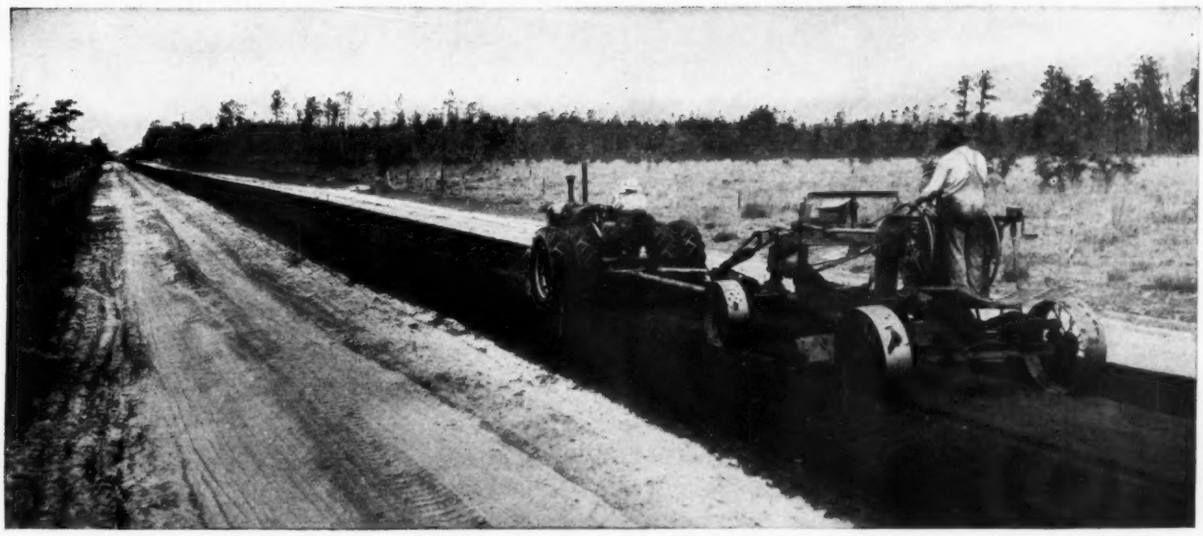
5. Although lime content allows sludge to be drawn in a less digested condition, the solids concentration may reach 25%, causing difficulty in obtaining flow through piping. Digested sludge containing spent lime is also more difficult to dry, requiring about 4 weeks as a minimum.

*For further information, consult M. M. Cohn, Schenectady, N. Y.

†John R. Downes used this method in 1923. His experiments and results were published in PUBLIC WORKS for July, 1923.

Modernizing Old Macadam Pavements

In an article under this head on page 21 of our September issue (sixth line from the bottom), we make Mr. Albrecht say that 54 sq. yd. of surfacing cost $7,500. The area was really 5400 sq. yd. Our mistake and our apologies to the author.



Blading: An International wheel tractor and an Adams 10-ft. blade grader

"Hot Blade" Expedites Mixed-in-Place Construction

WHATEVER the basic material, whether sand, sand-clay, limerock or shell, mixed-in-place roads are built in Hillsborough County, Fla., by G. F. Bullard, county road superintendent. The road material is disked, mixed with tar, bladed and rolled, the procedures below being followed irrespective of the material, except that as the proportions of limerock, shell or clay increase, more tar is needed. Finished surfaces 16 feet wide and 6 inches deep average $4000 per mile or less.

The steps in construction and the time required for equipment to perform each step, based on one-half mile of 16 ft. road are: 1. Disk the old surface (an I-30 wheel tractor pulling a 6½-foot disk harrow usually can do this work in a half day); 2. Grade to establish the contour (two wheel tractors, each with a 10-foot grader, usually do this in two hours); 3. Apply tar with a truck-mounted distributor. (the amount of tar depends on soil characteristics); 4. Thoroughly mix the surface with three wheel tractors, two pulling 10-foot graders and one an 8-foot grader, and a tractor pulling a 12-foot grader equipped with a special "hot blade" (the mixing usually takes about two days); 5. Roll (this usually takes about 1½ hours with two rollers); 6. After ten days, apply 0.3 gallon of tar per square yard as a surface seal, covering with ½-inch of sand; 7. Finally, after the road has been used about a year, apply a combination of 0.3 gallon of macadam binder and 30 pounds of trap rock or slag per square yard for surface treatment.

The "hot blade" speeds up the work

The "hot blade" (invented and patented by Mr. Bullard) is an Adams No. 12 manually controlled grader with a metal oven containing three evenly spaced kerosene burners bolted to the rear of the blade. Perforated baffles diffuse and direct the heat throughout the blade at any desired temperature from 300 to 500 degrees Fahrenheit. A Curtiss air compressor assists in feeding fuel to the burners under 75 pounds of pressure from a 42-gallon tank mounted at the rear of the grader. Ordinarily, 35 gallons of kerosene is enough fuel for 10 hours of work.

The blade has been extended vertically ten inches by welding onto it a curved, heat-resistant steel plate. This extension, which increases the heated surface and yardage capacity 30 per cent, permits a deep mix with no danger of material coming up over the blade onto the oven.

The heat of the blade increases the fluidity of the bitumen and permits quick evaporation of its volatiles. It has made possible the use of a heavy grade of bitumen that would quickly ball up on a cold blade. In this way Hillsborough county has reduced the amount of bitumen required and officials believe they obtain a better road.

There are several other advantages of the hot blade. Its ability to dry out damp or wet aggregates greatly reduces the construction delays which commonly occur

Mr. Bullard and some of his road-building equipment.

during cold or inclement weather. The thorough mix obtained, coupled with rapid stabilization, makes it possible to spread, finish-blade, roll, and open a road to traffic immediately without having waves, cracks, or ruts develop. This saves construction of detours during paving.

All work is done by the county with its own road building equipment, which includes one International TD-40 Diesel TracTracTor; one dual wheel ID-40 tractor; two I-30 wheel tractors; one International DS-40 truck; two International Harvester offset disk harrows; four Adams graders; an International-powered Austin-Western 3-wheel 5-ton roller; a Kinney distributor mounted on an International truck; an International-powered Bay City dragline; and a 3-wheel 6-ton roller. For purposes of maintenance, the county is divided into five districts (these use 17 International wheel tractors, 9 Adams graders and 5 disk harrows) but all road construction is done by a "county-wide" division under the supervision of Mr. Bullard.

The data in this article and the illustrations were obtained through the courtesy of International Power, publication of the International Harvester Co.

Toledo Water Supply Status

WITH planning 75% complete and contracts for 46% of the total work to be performed either awarded or about to be awarded, Toledo's new Lake Erie Water Supply Project is now well under way. Total cost, it is estimated, will run to $9,450,624.00 The new system is planned to take care of the city's needs until the year 2000, based upon a normal growth to 940,000 population in the area. Hitherto, the city's water has been taken from the Maumee River, and there has been possibility of shortage in dry weather.

The complete project breaks down into a number of divisions. Following the route of the water, there is first the intake crib and two-mile conduit located in Lake Erie between Reno Beach and Cedar Point. This is known as Division F. The intake is 108 inches in diameter, of reinforced concrete pipe. The next unit is a low-head pumping station at Reno Beach (Divisions Q, R, S, T, and U), on which bids are yet to be taken.

From the pumping station the pipe line runs a distance of almost nine miles to the filtration plant near Collins Park. This will be a steel line 78 inches inside diameter (79⅛" OD), and is separated into Divisions C, D, and E. The pipe is to be lined and coated with bituminous enamel supplied by The Barrett Company and the Wailes Dove-Hermiston Corporation. Subsidiaries of Bethlehem Steel Corp., Pittsburgh, and American Locomotive Co., New York, are supplying the pipe. Joints are being made with Dresser Couplings. W. A. Magee Co. of St. Paul is the contractor.

The next unit in the project consists of Division I, a 72 inch trunk main extending from Collins Park, at city limits, a distance of nearly two miles, to the intersection of Justice and Front Streets. Successful bidder on Division I was Lombardo & Co., Inc., Cleveland.

Division A, the next unit, is a tunnel crossing extending from Justice and Front Streets under the Maumee River a distance of 2,600 ft., ending at the foot of Magnolia Street. Inside diameter is 72 inches (73⅝" OD and 73⅜" OD). Division B, included in the same set of specifications, consists of a pressure-distribution or trunk main, of the same diameter, extending 4,800 ft. from the end of Division A to the intersection of Erie and Cherry Streets, in downtown Toledo. The last 500 ft. of this distance will be 42-inch pipe (43" OD). Pipe for Divisions A and B is being furnished by the subsidiary companies of Bethlehem Steel Corp., Pittsburgh, and is to be lined and coated with bituminous enamel; enamel is being furnished by the Steel Protection and Chemical Co., Inc., of Mooresville, Ind. Joints are being made with Dresser Couplings. The tunnel line is to be encased in concrete. The Kalill Company of Cleveland, Ohio, is the contractor on Divisions A and B.

Specifications on Division J (known as Crosstown Main) have been released but bids have not yet been received. This consists of a 60 inch and 42 inch main extending from Division B westerly along Woodruff Avenue as far as Ottawa Park, a distance of about 2½ miles; the last mile is 42 inch. Specifications on other divisions of the project yet to be released include the following:

Divisions V, W, X & Y: Collins Park main high-service pumping station.

Divisions K, L, M, N, & O: Purification Plant at Collins Park.

Division P: Filtered water reservoir.

The new system is planned to intercept and supply all of the present mains now a part of the existing Maumee River supply system. Work is being carried forward under direction of the Toledo, Ohio, Department of Public Service, Division of Water, Bureau of Engineering. Robert Furman is Commissioner, Division of Water, and George N. Schoonmaker is Chief Water Works Engineer. The Consulting Engineers are Greeley and Hansen of Chicago. The work is being done under P.W.A. grants.

The Editor's Page

Traffic Volume and Road Capacity

Average daily traffic volume, that is, the average number of vehicles that use a road per day, is not a good measure of the capacity of the highway or of its likelihood of traffic congestion. For instance, the Public Roads Administration has found that an average daily volume of 1500 vehicles means that in the maximum month the rate probably rises to 2000 per day, and with such a traffic, the rate during the maximum hour would be about 520 vehicles, which volume would cause considerable inconvenience. In fact, a flow exceeding about 400 vehicles per hour in both directions is the limit of a 2-lane highway. A four-lane divided highway will carry about three times as much traffic as a two-lane road.

Much light has been thrown on these and other factors of highway design and use by the studies that have been carried on over the past two or three years by the Public Roads Administration and the various states and counties. The data that have been accumulated show the great value of the 4-lane divided road for those areas where a high volume of traffic can be expected. Elsewhere, the need still remains for more and still more all-weather roads to carry every-day traffic needs.

Profitable Publicity by Public Works Officials

"Next Monday the Water Bureau will begin its fall inspection of hydrants and flushing of mains. This work will require about two weeks. During this time, consumers in the vicinity of mains being flushed may find the water from their faucets more or less roily. This is unavoidable, but the condition will last for only a few hours."

Such notice in the daily papers, or on a slip attached to the water bills, will forestall many time-consuming and temper-trying telephone calls, and obviate criticism of the department that is quite understandable. As a matter of fact, the consumers are entitled to an explanation, and one made *after* the happening is likely to be considered as an excuse for something that should not have happened.

This is only one suggestion of how to maintain pleasant relations between public works officials and the citizens they serve. We believe that if such officials are trying to give the best service they can, efficiently and economically, they can maintain such relations by making public all the details of the service that the average citizen is interested in, in a way that he can understand. The daily papers will be glad to help.

The annual report is another medium which is not given sufficient consideration. We believe that this also should be written for the average citizen, and as such should be brief, clear, non-technical and illustrated. Tables of minutiae have no place in such a report; if any citizen is interested in such data, however, they should be furnished to them at the office. Such report should be so presented that a taxpayer of average intelligence can learn the general feature and more important details of the work done during the year, why it was done, what it cost; and perhaps what is contemplated for the coming year and the reason therefor; all in fifteen to thirty minutes of reading.

The report may often, however, contain supplementary matter giving information of a technical nature to those able to understand it, which will often give favorable publicity among men engaged in similar work throughout the country for the city official, the department and the city administration. Among such information are, for example, details of operation of a sewage or water treatment plant. Said F. W. Mohlman recently: "The American annual report on sewage works is unique—there seems to be nothing like it in English, French or German practice. It has been responsible for great progress in the technical control of sewage treatment works, and has convincingly demonstrated that the sewage works operator should keep books just the same as the owner of a business. A little vividness of outlook, however, can help to transform dull columns of figures to an interesting record of accomplishment, and bring attention and acclaim to the author of the report."

Architecture for Sewerage and Water Plants

Some of the more recent plants for treatment of water and sewage have given attention to architectural treatment, either for the office and operating buildings, or for the entire plant. This is very desirable. There is no better way to create pride and interest in a water treatment plant on the part of the citizens (who are paying for it) than by having a smart, modern and attractive structure. Even more important, the inside should keep pace with the outside, as regards appearance and attractiveness.

There is no better way to insure that the plant will be kept clean and attractive than to build it so that human nature will want to keep it that way. In addition to modern appearance, modern conveniences should be provided. (At least one treatment plant has an outdoor privy in a corner of the grounds).

Human nature is an odd and peculiar thing. The average nose can discern odors from an unattractive plant that may be wholly imaginary, and that would never be considered as originating in what a modern and up-to-date plant should look like. So good architure may have a double value, reducing complaints and eliminating damage suits as well as creating in the taxpayers a pride and an interest that will result in proper maintenance and upkeep, even though it costs money.

T. R. Haseltine

Two Years' Experience W

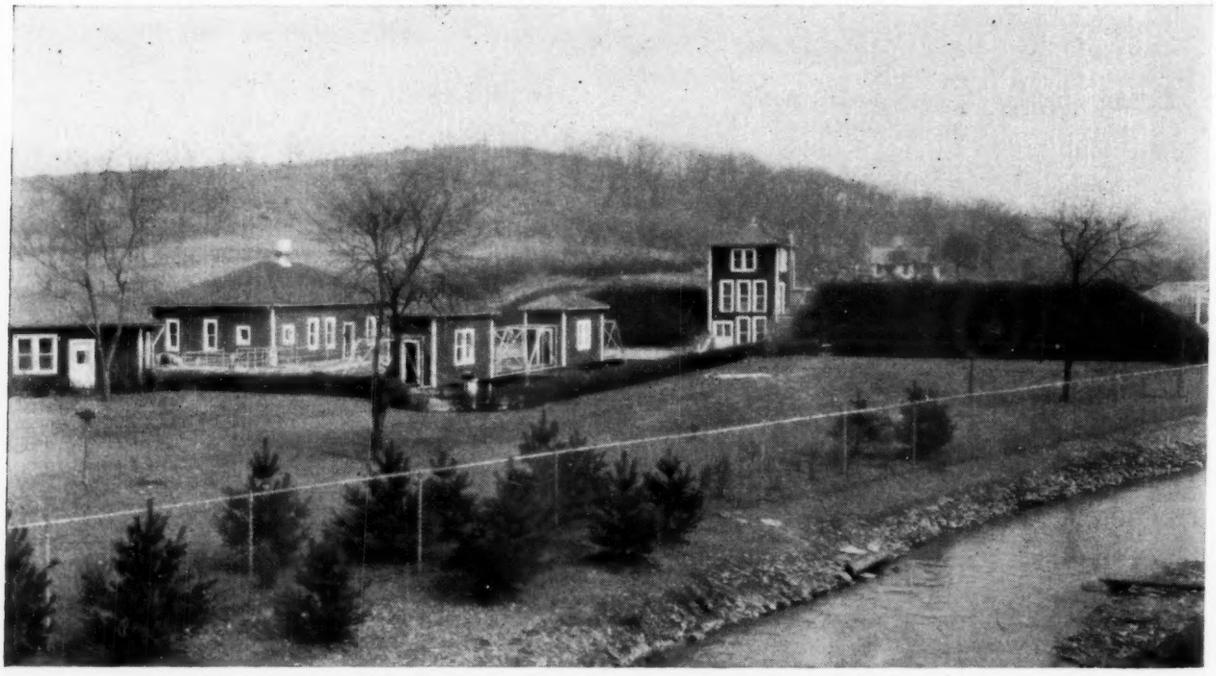
By T. R. HASELTINE

Superintendent, Sewage Treatment, Butler and Grove City, Pennsylvania

THE Butler, Pa. sewage treatment plant serves a population of approximately 30,000. Although all sewers are laid out on the separate plan, they are subject to considerable roof drainage and ground water infiltration. Normal dry weather sewage flow is about 2 mgd; during wet weather the flow occasionally exceeds 4 mgd—the capacity of the plant meter. The original plant, which first went into operation in 1927, provided plain sedimentation and separate sludge digestion. (1) In 1934 the plant was altered to facilitate the application of the Diamond Alkali Company, or "chlorinated sludge," process of chemical treatment (2). Apparently, the results obtained with that process did not justify its cost of operation and it was abandoned after about a year's trial. Later, the city used chlorine, lime and ferric chloride during periods of low stream flow in an attempt to augment plain sedimentation. However, the small amounts of chemical used, the lack of technical supervision and the type of equipment available, all combined to give far from satisfactory results. The State Department of Health requested the city to employ a technically trained man to operate the plant and to study means of increasing its efficiency.

Plant Description: The plant at that time consisted of a mechanically cleaned bar screen; a Link Belt grit chamber; a chemical dosing and mixing basin with about a one-minute retention period; two Dorr clarifiers, 50 ft. square by 6 ft. side water depth, operated in series; two digesters, each of which had seven compartments 16 ft. square by 26 ft. deep, equipped for heating but not for gas collection; twelve glass-covered under-drained sludge drying beds, 24 by 45 ft.; and a weir chamber and flow recorder for measuring the plant effluent. Final disposal was through 1500 ft. of 30-inch outfall to Connoquenessing Creek. A sludge pump house contained a Yeoman and a Fairbanks-Morse centrifugal sludge pump and a natural gas-fired boiler and circulating pump for heating the digesters. A chemical building housed three Wallace & Tiernan dry feed chlorinators, each with a nominal capacity of 300 lbs. per day; two Wallace & Tiernan lime feeders with a combined maximum capacity of about 70 lbs. per hour; and one Omega precision feeder for ferric chloride solution. Storage space was also provided for hydrated lime, purchased in car load lots; chlorine, purchased in ton containers; and liquid ferric chloride, purchased in 50 gallon rubber-lined drums; also a small laboratory.

Plant Changes Made in 1937: At the outset, it was realized that many changes were probably necessary,



General view of Butler sewage treatment plant. Left to right: Bar screen house. Grit chamber. Chemical house. Clarifiers. Sludge pump house and digester. Sludge drying beds (behind digester).

With Chemical Treatment of Sewage

Butler, Pennsylvania, has had two years' experience in operating its chemical sewage treatment plant, and all the details of procedures and results are given in an article by Superintendent Haseltine. But he not only operated A plant—he practically operated several plants. For he tried out various chemicals in various proportions, and compared costs and results for each combination to find the best and most economical. What he did and what he learned makes an interesting story.

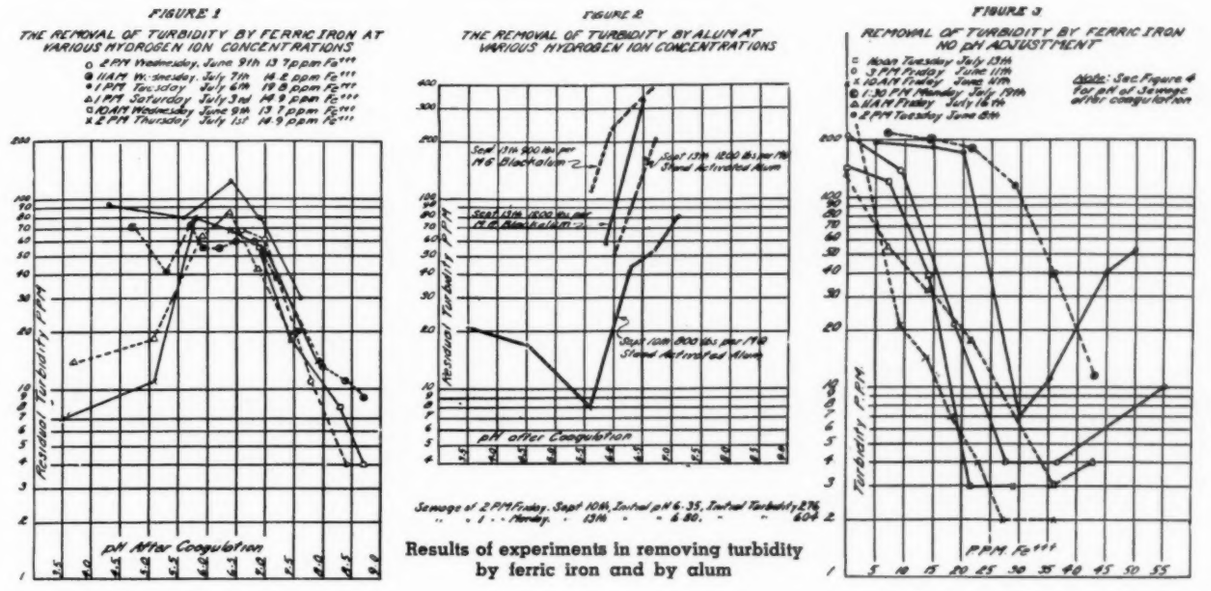


FIGURE 1
THE REMOVAL OF TURBIDITY BY FERRIC IRON AT VARIOUS HYDROGEN ION CONCENTRATIONS
Residual Turbidity PPM
pH After Coagulation
FIGURE 2
THE REMOVAL OF TURBIDITY BY ALUM AT VARIOUS HYDROGEN ION CONCENTRATIONS
Residual Turbidity PPM
pH after Coagulation
FIGURE 3
REMOVAL OF TURBIDITY BY FERRIC IRON NO pH ADJUSTMENT
Turbidity PPM
PPM Fe+++

Results of experiments in removing turbidity by ferric iron and by alum

but both the city and the state felt that considerable experimentation was required before the most advantageous arrangement could be decided upon. It was immediately evident, however, that the one minute of rather inefficient chemical mixing, with no provisions for flocculation, was entirely inadequate, no matter what chemicals were to be used eventually.

By altering certain channels about the plant, it was possible to provide a combined mixing and flocculating period of about 5 minutes in a basin 6 ft. by 25 ft., with a 7-ft. water depth, coagulant being added to the sewage in a baffled down-draft tube at the inlet end. Flocculation was assisted by air, introduced through elevated diffuser tubes along one side. The location of this basin was such that it could be readily extended. A Roots-Connersville blower having a variable output was installed. It was also believed that series operation of the clarifiers resulted in too high velocities to permit deposition of the lightest floc and so the clarifiers were changed to parallel operation.

The flocculation chamber was not ready for use until August 2 and the new blower could not be put in service until early in September. In the meantime, laboratory studies of the various phases of chemical treatment were conducted. Among other things, these studies showed the economical flocculating period varied from 10 to 20 minutes, being least for the weakest sewage.

Selection of the Most Economical Coagulant: Iron salts are the most commonly used sewage coagulants, so they were the first coagulants investigated. In addition to the commercial salts, the following are locally available: (a) crude copperas, a by-product of the Butler works of the American Rolling Mill Company; it is damp, lumpy and sufficiently acid to rot burlap sacks in a few weeks' time; (b) pickle liquor from the same concern or from tube mills; this is essentially a mixture of copperas and suphuric acid and might be chlorinated to produce coagulation at a low pH.

It is generally agreed that all iron salt coagulants are equal when compared on their ferric iron contents. Our laboratory and later plant scale tests with ferric chloride and chlorinated copperas showed this to be true for the Butler sewage. In view of the chemical costs given in Table I, chlorinated copperas made from the Armco crude copperas at $10 per ton, and chlorine at $2.59 per 100 lbs. in one-ton containers, was the cheapest suitable iron coagulant.

TABLE I—1937 Chemical Costs per 100 Lbs. f.o.b. Butler

Liquid ferric chloride	$4.65
Anhydrous ferric chloride	3.30
"Ferrisul," anhydrous ferric sulphate	1.925
Copperas, commercial, sugar	0.785
Copperas, Armco, crude	0.50
Standard activated alum	1.27
Black alum	1.37
Chlorine (ton containers)	2.59
Hydrated lime	0.525
66% sulphuric acid (approximate only)	1.00

Later, several laboratory tests were made with "standard activated alum" and with "black alum." These tests showed (a) the standard alum to be slightly superior to the black alum, and (b) that either coagulant could produce as good results as did lime and ferric iron, but no better. At the 1937 prices, chemical costs would probably be higher when using alum than when using lime and iron. If acid was used to lower the pH, less alum would be required, but the chemical costs would be still higher. Therefore, no alum was tried on a plant scale during 1937. However, the cost of activated alum in 1938 was reduced to $1.00 per hundred pounds, so plant scale runs were made with that coagulant then, as will be described later.

Optimum pH for Coagulation of Butler's Sewage: Several groups of laboratory tests were made in which various samples of the same sewage were dosed with the same amount of ferric iron, but varying amount of acid or lime, flocculated for six minutes, the pH determined, and allowed to stand. After one hour of quiescence, turbidities were determined. Figure 1 shows the results of a few such groups of tests. These tests showed the following: (a) That as the pH of the sewage was increased beyond 7.0, the effectiveness of the coagulant was increased markedly up to a pH of about 9.0; no tests were made at higher pH values. This increase was quite uniform, regardless of the strength or character of the sewage. (b) That as the pH of the sewage was reduced from 7.0 to between 6.4 and 6.0, the effectiveness of the coagulant reached a minimum. (c) As the pH of the sewage was further reduced by the addition of sulphuric acid, the effectiveness of the coagulant again increased, becoming most effective somewhere in the pH range 5.3 to 3.6. However, it seldom, if ever, was as effective at this low pH range as it was at a pH of 8.0 or higher. The amount of this increase in effectiveness and the point of optimum coagulation at low pH varied greatly with the strength and character of the sewage. (d) Whenever the pH was reduced below the optimum low value for the particular sewage being tested, the effectiveness of the coagulant decreased markedly. Occasionally the coagulant was even less effective at a pH of 4.7 to 3.0 than it was at values beteween 6.0 and 7.0.

While making these tests, it was noted that the floc formed at low pH values was bulky, slow-settling and easily disturbed after settlement; the supernatant liquor, while clear, frequently had a slight yellow color. However, the full significance of this observation was not realized until after the plant scale operation was in progress.

The generally poorer results of coagulation of the Butler sewage at a low pH value as compared with those at high pH values, and the wide fluctuations in the results obtained in the acid range, led to the conclusion that chlorinated pickle liquor from the steel mills would not be a satisfactory coagulant.

Only a few tests were made to determine the optimum pH for alum coagulation. Those tests indicated that best results were obtained over a narrow pH range in the vicinity of 5.6 (see Figure 2). It should be noted that in all these laboratory tests the lime or acid was added first and then the coagulant. Rudolphs and Gehm (3) have since shown that this order of chemical addition gives the best results when lime is used but that the reverse order gives best results when acid is used. Their findings do not alter our conclusions with respect to the pickle liquor because if that was used the acid and iron would be added simultaneously.

Amount of Coagulant Required: In the laboratory work reported herein, a flocculating period of 6 to 7 minutes was used and it was assumed that the residual turbidity in a satisfactory laboratory effluent should not exceed 20 p.p.m. Figure 3 shows the results of several tests in which ferric iron alone was used. As might be expected, the required amount of coagulant varied with the strength and character of the sewage. These tests indicated that from 10 to 25 p.p.m. of ferric iron would be required when no lime was used. However, on Monday afternoons, when large amounts of laundry wastes are in the sewage, almost prohibitive amounts of iron are required. These tests further showed that if more than the optimum amount of iron was used, inferior results might be obtained.

The addition of a ferric iron coagulant to sewage reduces its pH. However, the amount of such reduction for a given amount of coagulant varies with the character of the sewage. At Butler, it appears that such reduction is greater in the morning sewage than in the afternoon sewage and least in the strong soapy sewages. Figure 4, which covers some of the same tests shown in Figure 3, indicates that, regardless of the character of the sewage, best results were obtained when sufficient coagulant was used to reduce the pH of

FIGURE 4

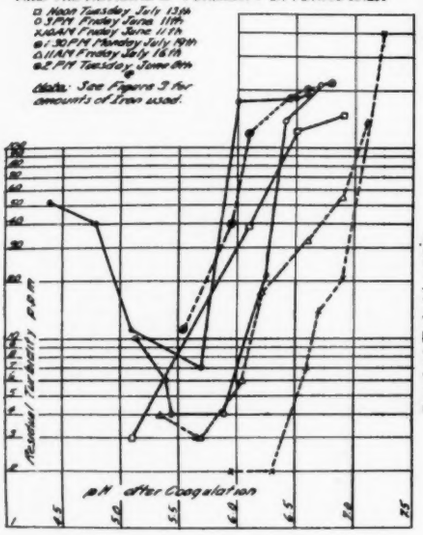

CORRELATION BETWEEN pH OF COAGULATED SEWAGE AND THE REMOVAL OF TURBIDITY BY FERRIC IRON
Noon Tuesday July 13th
3 P.M. Friday June 11th
9 A.M. Friday June 11th
1:30 P.M. Monday July 19th
11 A.M. Friday July 16th
2 P.M. Tuesday June 8th
Note: See Figure 3 for amounts of Iron used.
Residual Turbidity P.P.M.
pH after Coagulation

FIGURE 5

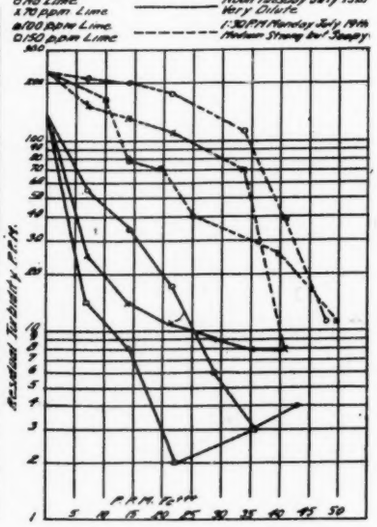
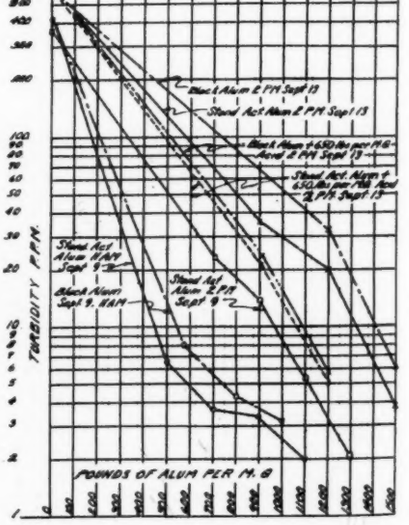
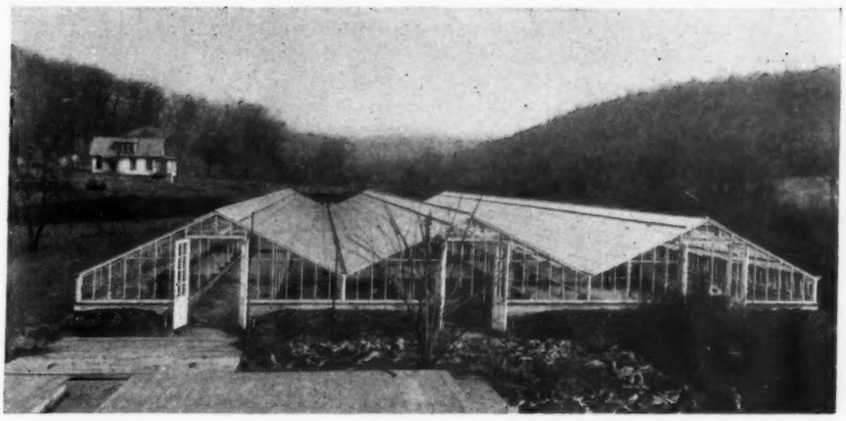

EFFECT OF LIME ON THE REMOVAL OF TURBIDITY BY FERRIC IRON
No Lime.
70 p.p.m. Lime.
100 p.p.m. Lime.
150 p.p.m. Lime.
Noon Tuesday July 13th Very Dilute.
1:30 P.M. Monday July 19th Medium Strong but Soapy.
Residual Turbidity P.P.M.
P.P.M. Fe2(SO4)3

FIGURE 6


THE REMOVAL OF TURBIDITY BY ALUM
Black Alum 2 P.M. Sept 13
Stand. Act. Alum 2 P.M. Sept 13
Black Alum 9 A.M. Sept 9
Stand. Act. Alum 2 P.M. Sept 9
TURBIDITY P.P.M.
POUNDS OF ALUM PER M. G.



Sludge drying beds. Operator's dwelling in background. Part of digester in foreground.

the sewage to between 5.7 and 6.0. If such a phenomenon is generally true, it is very significant for two reasons: First, it offers an easy, rapid method of controlling the coagulant dosage when no pH adjustment is used. Second, it indicates that the hydrogen ion concentration after coagulation is just as important when ferric iron alone is used as it is when the iron is used in conjunction with acid or lime, although the optimum pH for coagulation is quite different.

Figure 5 shows the results of a few tests in which lime was used in conjunction with various amounts of ferric iron. Many similar tests were made on sewages of various strengths and characteristics. Seventy ppm of lime were used in all cases because that represented the probable dosage that could be obtained in plant scale operation with the existing lime feed machines. Higher amounts of lime were also tried in an effort to learn whether or not increased lime feeder capacity was economically justified.

These laboratory tests indicated that, at the chemical prices prevailing in Butler, the use of lime would not reduce the cost of treatment and might increase it slightly. Therefore, it was anticipated that no lime would be used except on Mondays or other days when unusual amounts of coagulant were required. However, when plant scale operation was tried, this practice was not successful, as will be explained later. Figure 6 shows the results of a few tests in which "black alum" and "standard activated alum" were used with and without the prior addition of sulphuric acid.

Plant Operation in 1937: Chemical treatment on a plant scale was started on August 2 and continued until the middle of October, at which time creek conditions warranted its discontinuance. As a rule, chlorine was used continuously; chlorinated copperas and lime were used from 9:30 a.m. to 11:00 p.m. on week days and from 10 a.m. to 6 p.m. on Sundays.

However, there were frequent interruptions to this program, due principally to chlorinator troubles. Earlier difficulties in applying gaseous chlorine to sewage had led the city engineer to install some home-made injectors which put at least part of the chlorine in solution before application. Without those injectors, the chlorinators would have been practically useless. However, the injectors frequently permitted moisture to enter gas lines. Leaks were an everyday occurrence and frequently a chlorinator became partially or totally clogged.

During the first two or three weeks, considerable trouble was also encountered in feeding the crude copperas. The moist, lumpy character of that material made us doubt that it could be fed by a dryfeed machine, and, in any event, we had no such machine available for that purpose. Our Omega feeder, which had been used for feeding ferric chloride solutions, had two rubber-lined 200-gallon tanks. At the start we attempted to dissolve copperas in one tank while feeding from the other and vice versa. Even with warm water, we could not get a strong enough solution to give an adequate dosage when feeding from only one tank. At the same time, so much copperas failed to dissolve that we had considerable trouble with stoppages in our feed lines. To overcome these difficulties, we installed an 850-gallon wooden tank for dissolving the copperas. An air-lift was used to circulate the solution in this tank and to transfer it to the solution feeder. This scheme was quite satisfactory, except for the rapid corrosion of iron pipes and fittings used in the air-lift which had to be replaced about every two weeks. The copperas solution usually contained about 0.55 pound of iron per gallon. The same solution tank was used in 1938 but a lead pump and rubber hose lines were installed for handling the copperas solution.

Chlorine for oxidizing the copperas was applied to the discharge hose from the copperas solution feeder. The chlorinated copperas was mixed with the sewage in the downdraft tube at the inlet of the new flocculating basin previously described. At times, a considerable excess of chlorine over that required by the copperas was applied at this point. Chlorine could also be applied to the clarifier effluent and, when equipment permitted, this was done whenever necessary to insure a residual in the plant effluent.

Lime, when used, was applied ahead of the bar screen. On several different occasions, no lime was used in order to determine its benefits, if any. When it was used, the two lime feed machines were always operated at their maximum rates. This gave us lime dosages ranging from 40 to 100 p.p.m. and averaging about 80 p.p.m.

As a means of odor control about the plant, it was necessary to apply at least a small amount of chlorine to the incoming sewage ahead of the bar screen. The rate of such application ranged from 90 to 340 pounds per day, for reasons to be discussed later.

Table II, (next page) shows the average chemical composition and results obtained over the entire operating period from August 2 to October 16, inclusive, 1937. It should be noted that all analyses were made on composites of hourly samples collected from 8 a.m. to 10 p.m. inclusive, while chemical coagulation was employed (barring mechanical difficulties) from 9:30 a.m. to 11:00 p.m. Therefore, the actual degree of treatment was probably slightly higher than indicated in the table. No composite samples were collected on Saturdays and Sundays.

The results obtained during 1937 were quite variable, due in part to mechanical difficulties and in part to intentional fluctuations in amounts or points of application of the various chemicals used. During that period, the writer formed several opinions regarding the use of chemical coagulation at Butler. Perhaps Tables III and IV will serve to illustrate, if not to prove, the following conclusions:

TABLE II

Year	*1937*
From	*Aug. 2*
To	*Oct. 16*
Total daily sewage flow, M.G.	2.11
Hrs. per day coagulation used	12.17
Sewage flow coagulated, M.G.D.	1.17
Activated alum used, lb. per day	0
Chlorinated copperas used, lb. per day	1180
Hydrated lime used, lb. per day	740
Post-chlorination, lb. per day	70
Pre-chlorination daytime, lb. per day	94
Pre-chlorination night, lb. per day	58
Settleable solids, cc/liter raw	7.5
Settleable solids, cc/liter effluent	0.78
Settleable solids, cc/liter % removed	89.7
Suspended solids, p.p.m. raw	303
Suspended solids, p.p.m. effluent	82
Suspended solids, p.p.m. % removed	73.0
Turbidity, p.p.m. raw	309
Turbidity, p.p.m. effluent	110
Turbidity, p.p.m. % removed	64.4
5 day B.O.D. raw	339
5 day B.O.D. effluent	140
5 day B.O.D. % removed	58.7
Volume if sludge produced, C.F.D.	2527
Average sludge analysis:	
pH	6.50
% solids	4.35
% organic	62.8
No. of samples	20
Daily cost of coagulation	$12.62
Daily cost of chlorination	5.76
Total daily chemical cost	18.37
Cost of coagulation only, per 1000 lbs. B.O.D. removed	6.50

1. Even when 50 to 80 p.p.m. of lime were used, 18 to 23 p.p.m. of ferric iron were required. If any less coagulant was used, very inferior results were obtained—compare August 6 and August 25, Table III. The use of much more coagulant did not improve the B.O.D. reduction, decreased the removal of suspended matter and gave a yellow color to the effluent—compare August 26 and August 27, Table III.

2. Although it is possible to get as good reductions in B.O.D. and turbidity by using more iron and no lime, the removal of suspended solids is poorer and the effluent has a very pronounced yellow color; there is little difference in the overall cost of chemicals—compare August 6 and August 24, Table III.

3. There is little, if any, increase in B.O.D. reduction as a result of maintaining a residual chlorine content in the effluent, although the cost of chemicals is materially increased—compare August 6 and August 24 with August 26 and August 27, Table III. However, it does not follow that the residual chlorine does not delay the rate of oxygen consumption during the first few hours, or even days, after the effluent leaves the plant. The advocates of chlorination make that claim for it and the writer's observations along Connoquenessing Creek give him the impression that such claims are justified, although no positive proof can be presented. At any event, the State wants a chlorine residual in the effluent during warm weather, because of the recreational uses made of the creek some miles below our plant.

4. For some time we attempted to carry a chlorine residual through the entire plant in order to preclude any reduction of ferric iron to ferrous iron, even though it was logical to believe that the chlorine demand of the treated sewage would be materially less than that of the raw sewage. While attempts to operate the plant without any prechlorination at all gave such poor results that we never continued them over a full day, we did find that it was not necessary to carry a residual through the plant and that there was a substantial saving in total chlorine required when a relatively large proportion of it was applied to the effluent instead of to the raw sewage, as evidenced by Table IV. This saving in chlorine was possible without reducing the effectiveness of the ferric iron coagulant.

References:

(1) Sewage Works Journal, page 414, July 1931.
(2) Sewage Works Journal, page 1053, November 1935.
(3) Sewage Works Journal 10, page 457, May 1938.
(4) Jour. Am. Water Works Assoc. 20, page 467 (1928).

(To be concluded in the November issue)

TABLE III

DATE	*Aug. 6*	*Aug. 24*	*Aug. 25*	*Aug. 26*	*Aug. 27*
Sewage flow 9:30 a.m. to 11 p.m. M.G.	1.42	1.56	1.46	1.42	1.42
Ferric iron used p.p.m.	18.9	25.5	15.6	18.9	29.2
Lime used p.p.m.	58.3	0.0	56.8	58.3	58.3
Chlorine to sewage ahead of plant p.p.m.	9.8	10.7	11.6	18.3	11.2
Chlorine to effluent p.p.m.	0.0	0.0	0.0	4.4	5.5
Average chlorine residual in effluent, 10:30 a.m. to 5:30 p.m.	0.0	0.0	0.0	2.0	1.1
pH of raw sewage	6.7	6.7	6.65	6.6	6.7
pH of plant effluent	7.2	6.4	7.15	7.1	7.05
Settleable solids raw sewage cc/1	8.0	6.0	8.0	7.0	8.0
Settleable solids effluent cc/1	0.5	1.0	1.0	1.0	0.9
Settleable solids % removed	93.7	83.3	87.5	85.7	89.2
Suspended solids raw sewage p.p.m.	458	226	314	252	294
Suspended solids effluent p.p.m.	82	82	88	46	87
Suspended solids % removed	77.5	63.7	72.0	81.7	70.7
Turbidity of raw sewage p.p.m.	256	184	208	156	192
Turbidity of effluent p.p.m.	98	69	93	48	48
Turbidity % removed	61.6	62.3	55.3	69.2	75.0
5-day B.O.D. raw sewage p.p.m.	273	272	351	342	362
5-day B.O.D. effluent p.p.m.	93	100	197	192	153
5-day B.O.D. % removed	65.8	63.2	43.9	62.3	59.4
Cost of chemicals per M.G.	$11.29	$11.16	$10.40	$14.00	$16.28
Cost of chemicals per day	16.00	17.40	15.20	19.88	23.10
Coagulant cost per 1000 lbs. B.O.D. removed	6.14	6.19	6.19	5.15	7.41

TABLE IV—Chlorination

Number of Days	*Average Sewage Flow M.G.D.*	*Chlorine Used—Lbs. 10 Hrs. of Night*	*14 Hrs. of Day*	*Per cent of Daytime Consumption Used on Effluent* Range	Average	*Average Daytime Residual Chlorine*
4	2.23	42	266	21.3 to 27.1	24.6	1.1
3	2.03	46	208	32.6 to 39.5	35.1	1.0
8	1.95	45	177	42.6 to 49.8	46.7	0.7
11	2.04	48	175	51.5 to 59.6	54.5	0.8

Note: Sundays, Mondays, days when chlorine residual was lost due to chlorinator breakdowns or other causes, and days when insufficient residual determinations were made, are excluded from this table.

V-plow and wings working on a motor grader clearing a rural highway.

How Snow Removal and Ice Control Pay Dividends

(Continued from page 17)

regularly, garbage and ash removal stays on schedule, the usual amount of gasoline is used, fewer accidents occur, no deep ruts form on the streets, and when it thaws or rains, water can get to the catch basin readily."

Ann Arbor, Mich. A concise statement of the benefits are listed by *George H. Sandenburgh,* City Engineer, as follows: Reduces traffic hazard, lowers cost of motor vehicle operation, gives better fire protection and helps business.

Fort Dodge, Ia. *J. L. Parsons,* City Engineer and Street Superintendent, says: "Effective snow and ice removal during the past two years has resulted in such spontaneous approval from business men and the public generally that we feel there must be some advantages."

South Bend, Ind. "Snow removal from the walks in the residential sections pays dividends in good will. Snow removal from the streets in the business sections speeds up traffic, provides better fire protection and improves business generally. It has a limited effect on the gasoline tax returns to the city." *Clyde E. Williams,* City Civil Engineer.

Augusta, Me. *Waldo W. Hill,* City Engineer, says: "There is no doubt but that snow removal is worth all that it costs, especially in the business sections. The same is true, of course, throughout the city, and it has been definitely proved by the state that the gasoline tax income throughout the winter months pays for all snow removal costs, besides providing for better fire and health protection."

Oil City, Pa. "Normal business would be impossible without snow removal, at least in case of snowstorms of any magnitude." *B. B. Webber,* City Engineer. "Better fire and health protection," says *Leland L. Graham,* City Engineer of Jamestown, N. Y. "Pays big dividends; all streets are opened within 24 hours" states *John Barth,* City Engineer, LaCrosse, Wisc.

The unanimous opinion of these widely scattered men, each judging from his local viewpoint, have been presented to indicate that the demand for snow removal is based on a sound need. It will be noted that many county engineers stressed the value of snow removal for fire protection. Not so many years ago, farmhouses in which fire started were doomed. The salvage of a little personal property was the best that could be hoped for. Today, many farm sections enjoy a real degree of fire protection through the formation of fire districts and the provision of motorized apparatus with both water and chemical equipment. But open roads are absolutely necessary, or the protection paid for will not be available during the season of the year when the risks are greatest.

Maintenance In Our Cities

Some claim that snow removal reduces maintenance costs on streets and highways; others disagree. Here is what the men above mentioned replied to the question: "Does snow removal reduce maintenance cost?"

Snow removal does not reduce the cost of maintaining macadam streets, *J. Francis Poole.* "Yes. If snow is not removed, traffic moves in definite lanes, and this concentrated traffic wears out the pavement surface faster." *George H. Sandenburgh.* "Maintenance costs are reduced very materially by snow removal, as accumulations of snow and ice result in an unmerciful pounding of the surface by cars and trucks during the melting period, which is very damaging, especially to old pavement." *J. L. Parsons.* "In our opinion, snow removal does not materially affect our street maintenance costs." *Clyde E. Williams.* "As to reducing maintenance costs, I feel the opposite is true as by keeping the roads and streets bare, the frost penetrates deeper and is longer coming out in the spring which, of course, gives unpaved streets and roads a longer period over which they must stand up, in their weakened condition, and causes more breakdowns." *Waldo W. Hill.* "Yes, particularly bituminous types; tire chains running in ruts do considerable damage to these. *B. B. Webber.* "No." *Leland L. Graham.* "No." *John Barth.*

What Counties Say

"Snow removal does reduce surface maintenance costs on our highways. Just what this amounts to I am unable to state. I base my judgment on the fact that our roads, especially gravel roads, where the snow was not removed or was only partially removed, cut up considerably more in the spring. This caused the loss of considerable gravel, and also required more maintenance to put the road back into shape again." *C. A. Boeke.* "It is my opinion that removal of snow and the proper drainage effected thereby reflects favorably on the annual maintenance costs of our county roads." *Robert F. Knox.*

"Better drainage and less water on the traveled way is effected by snow removal." *Clarence Hoff.* "As far as we can judge, there seems to be little after-effect as regards surface maintenance, whether snow and ice are removed or not. If anything, we believe that snow removal increases the amount of surface road maintenance on all roads except hard-surfaced ones because they are traveled more." *Arthur F. Ranney.*

Snow removal "permits traffic to use the full width of the road surface instead of forming surface ruts." *K. L. Hallenbeck.* "Snow removal does reduce surface maintenance costs on highways and streets as it eliminates the formation of ice. Water from melting snow and from rains is allowed to run off freely to the ditches instead of aiding in the destruction of the surface." *W. W. Chadsey. George W. Buck* doubts if snow removal reduces surface maintenance costs.

In summary, snow removal and ice control in many or most cases appear to reduce surface maintenance costs, even though the roads have to carry a greater amount of traffic than they would if they were not plowed. It seems safe to conclude that the many benefits derived from keeping the roads open far outweigh any increased costs where they exist due to local conditions. And if the annual cost of the road is computed on the basis of vehicle-miles traveled over it the comparison is still more in favor of year-around usage through snow plowing.

Difficult Problems in Snow Removal and Ice Control

IN A recent questionnaire to a selected list of city and county engineers, we asked "what have been your most difficult problems in snow removal and ice control?" The replies to this question are interesting, and we present a number of them here.

Among city engineers lack of sufficient funds seems to be more or less general. Says one: "My biggest problem is to get enough money to do the job with." Another: "Our most difficult problem has been obtaining adequate appropriations each year." "Our biggest problems are due to having insufficient equipment and to lacking money for the purchase of chemicals." "We have been handicapped more or less in snow removal by breakdowns of worn-out equipment, but at the present time we are in pretty good shape."

Among difficulties encountered in performing the work, one engineer says that "Parked cars hinder both plowing and loading." In another city automobiles in the streets and parked constitute a great handicap to snow removal work.

A mid-west city engineer says that his most difficult problem has been to haul away the snow from about two miles of business streets rapidly enough to prevent it from packing under traffic; a problem which has partly been solved by the use of night crews. Another in the central area reports his greatest worry lies

FRINK
SNO-PLOWS
REG. U.S. PAT. OFF.

A New FRINK CATALOG
(Just off the press)
WILL MAKE IT EASIER FOR YOU TO SELECT THE PROPER SNOW-PLOWS FOR YOUR MOTOR TRUCKS

"V" Type and One-Way Blade

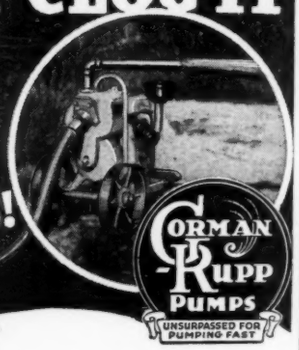
Write today for your copy of catalogs No. 39PD and 39EP

Hand or Power Hydraulic Control

CARL H. FRINK, Mfr., CLAYTON, 1000 Isl., N. Y.
DAVENPORT-BESLER CORP., DAVENPORT, IOWA
FRINK SNO-PLOWS OF CAN. Ltd., TORONTO, ONT.

YOU CAN'T CLOG IT

MUCK!
GRAVEL!
CINDERS!



GORMAN-RUPP PUMPS
UNSURPASSED FOR PUMPING FAST

"Old Faithful" that's what construction and maintenance men everywhere call their G & R self-priming centrifugal pumps. Fool proof because they're gadget-less. They've got something the others haven't — simplicity. They can't clog — they're not quitters.

The only pumps with renewable wearing plate—they're modern.

G & R's will deliver more water per hour and pump more hours at less cost—under any conditions.

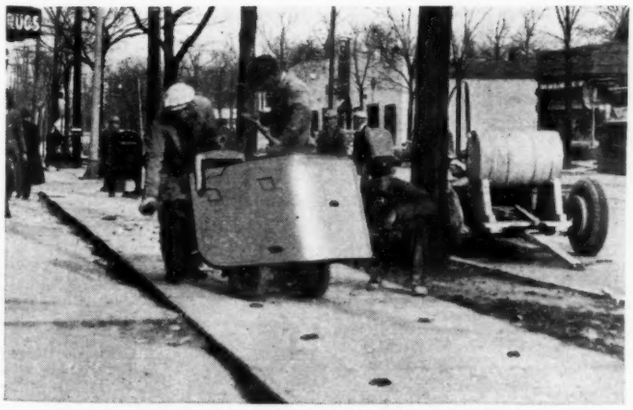
WE WILL SHIP YOU ONE and LET YOU BE THE JUDGE!

You'll find them THE MOST DEPENDABLE PUMPS FOR THE LEAST MONEY—bar none.

PROMPT DELIVERY ---- from Stock In 100 Principal Cities ....

WRITE ↘

THE GORMAN-RUPP CO., Mansfield, Ohio



CUT MAINTENANCE COSTS 75%

Concrete slab maintenance costs can be reduced as much as 75% by the Koehring Mud-Jack Method. The Koehring Mud-Jack raises sunken concrete . . . walks, curb and gutter, driveways, streets, highways, etc., eliminating reconstruction costs. Write for the new Mud-Jack Bulletin illustrating applications and describing the Mud-Jack Method.

KOEHRING HEAVY DUTY

KOEHRING COMPANY
MILWAUKEE • WISCONSIN

MUD-JACK METHOD

HERE'S

TRIPLE PROTECTION

FOR OVERHEAD STRUCTURES

Now comes a new development that promises long protection for overhead structures. ARMCO Bonded-Metal Blast Plates give you triple assurance of low-cost service.

First, the base metal is durable ARMCO Ingot Iron — proved by more than 33 years of service under corrosive conditions. Second, you have the added protection of a uniform zinc coating. And finally, a special bituminous material is tightly bonded to the base metal by ARMCO's Asbestos-Bonding process. All of which provides triple-protection against fire-box gases, blast fumes and severe cinder action. Long life and economy are assured.

Learn more about ARMCO Bonded-Metal Blast Plates, how they can save you money. Write for complete story. The American Rolling Mill Co., 1811 Curtis Street, Middletown, Ohio.

ARMCO

ARMCO BONDED-METAL BLAST PLATES

in getting rid of the snow from the business districts.

Other problems mentioned are "the laying out of routes for each piece of equipment, meanwhile holding some one responsible for the condition of each section." "Probably our most difficult problem now is in controlling traffic both during storms and after." A Pennsylvania city engineer says that his greatest difficulty has been in ice control, due to the impossibility of cindering all streets at once.

County Problems

In county snow removal and ice control the problems are somewhat different. Financial problems do not seem to be so pronounced, although one county engineer says: "Shortage of heavy equipment is our trouble. The counties in this state inherited many miles of township roads and had insufficient money for bare maintenance and none for equipment purchases. Therefore, we are all handicapped until sufficient equipment can be accumulated. The same general statement applies to ice control—lack of equipment."

A mid-west county engineer says that his most difficult problem in snow removal is caused by the narrow rural roads. In some cases these are only 40 ft. wide between the fence lines, and this is not wide enough for the larger plows. On newly constructed roads this condition has been remedied by making them wider.

An eastern highway superintendent says that high winds have been his most serious handicap in keeping roads open and free from icy and slippery spots. (Where the roads can be raised slightly above the surrounding land, winds become an asset rather than a liability.) In the far west, a county engineer reports that his most serious troubles occur when big drifts in the mountain areas of his county are not cleared promptly; they quickly turn into ice, which can be removed only by the heaviest equipment — as power shovels—or by blasting.

Ice causes the most trouble for a highway commissioner in a north central state. Due to rapid weather changes, a surface that is clean at 6 o'clock in the evening may be covered with ice before midnight, and in this short time it is impossible to safeguard all the roads. Another from the same general locality writes: "Our most difficult problem is the freezing glaze that sometimes follows the removal of snow, due to low temperatures. We cure this by the generous use of cinders and salt."

Everyone Wants Snow Removal

An eastern county highway superintendent states: "Our greatest problem is removal of snow in such an expeditious manner as will satisfy all concerned. I believe the demands of our taxpayers with respect to snow removal are yearly increased. Some of these demands are reasonable, but I regret that many cannot be so classified. It may be that by the means of some form of educational publicity we may obtain better cooperation in the form of constructive criticism."

The purpose of this brief survey of worries and troubles is not to make the man charged with this work feel too sorry for himself; but rather to show that snow removal and ice control are exacting jobs that require not only planning, foresight, hard work and leadership, but also the best and most modern suitable equipment. Combatting the forces of nature is never an easy job. The open roads that greet the motorist the morning after a heavy snow storm are visual evidence of the efficiency of our highway and street organizations, often against heavy odds. It is remarkable that the problems incident to doing this have been so well solved over such a wide area.

Iron Bacteria: Classification, Identification and Treatment

(Continued from page 23)

probably use other constituents present in the iron salts to throw down ferric hydroxide as a waste product. A number of this type have been isolated and their characteristics learned, but they are not so common or troublesome as the filamentous type.

Hydrogen sulphide also is formed by bacteria by the decomposition of sulphur-bearing proteins and reduction of sulphur. These appear as long, tubular threads capable of movement; in mass growths they form a dark gray, loosely textured mat and may be found clinging to the walls and bottoms of reservoirs.

Identifications of Iron Bacteria

The writer has found the identification of iron bacteria more or less difficult for several reasons, probably because most analysts are not acquainted with them or the possibility of their presence. It is necessary, therefore, where iron bacteria are suspected, to use methods for determining their presence different from the ordinary laboratory determinations. Some of the better known forms, such as Crenothrix, can be recognized by the eye, especially when well developed.

Kenneth W. Brown, sanitary engineer for the California Water Service Company, Stockton, Calif., has outlined the following procedure:

Filter through a Berkefeld filter, generally by attaching the filter to the discharge of a pump for a week or ten days. The dark brown mud filtered out can be examined for iron bacteria. Or examine material scraped from the covers of check valves on the pump discharge lines from infected wells. Or a reliable method is to collect a sample from a suspected well in a sterile bottle and allow it to stand at room temperature for a week or ten days. If iron bacteria are present, a white or brown deposit will appear which, on microscopic examination, will furnish definite information as to the identity of the organisms.

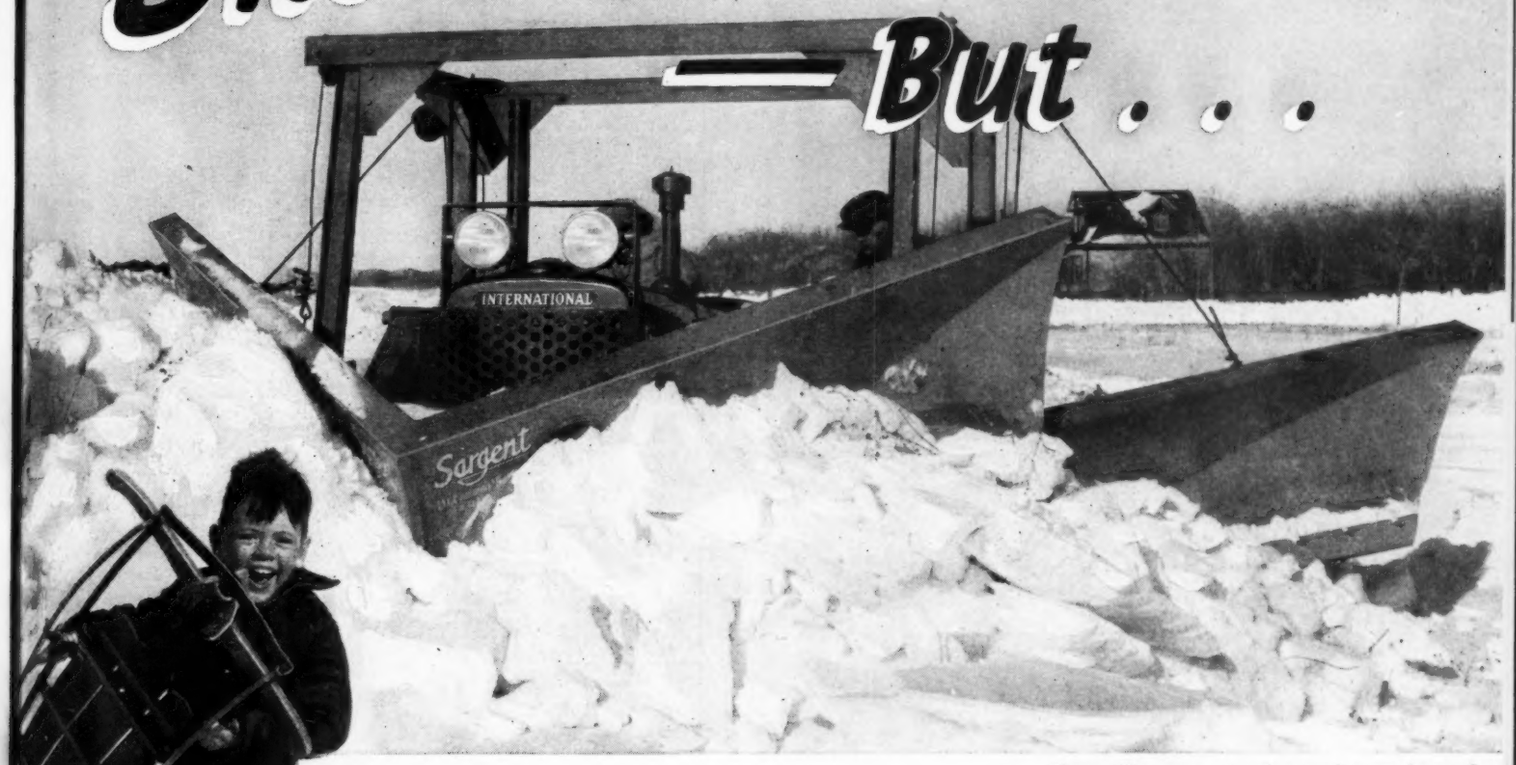
Mr. Brown found that the easiest and best way to prepare specimens for the microscope was: 1) For Leptothrix, Cladothrix and Crenothrix, treat the coated threads with 1:2 hydrochloric acid, which dissolves the iron deposits, then stain the uncovered membranes with iodine. 2) For Gallionella and Spirophyllum this method is unsatisfactory because of the delicacy of these organisms, and unstained specimens generally give best results, although fair results are obtained with carbol fuchsin. 3) For the bacillus forms of iron bacteria, ordinary methods of staining and mounting are satisfactory.

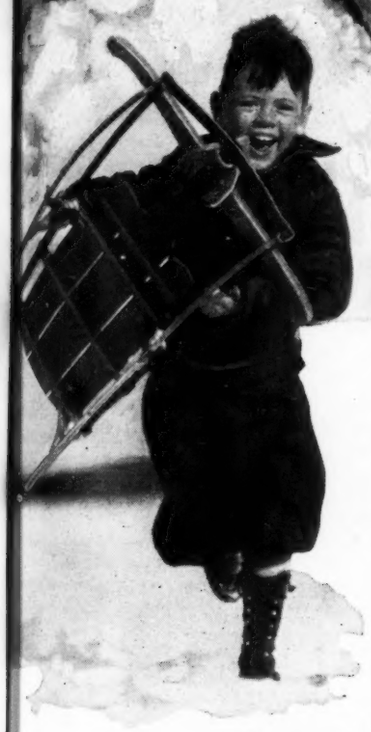
Corrective Methods

For years the use of copper sulphate and chlorine has been recommended for controlling iron bacteria, but in the writer's experience cases have been noted where neither of these remedies seemed to be effective. Possibly this was due to a wrong application and use of the chemicals. Iron bacteria are tenacious and continue to grow even after the severest kind of treatment; furthermore, they generally re-occur no matter what treatment is used and if relief is had it is likely to be temporary. Mr. Brown found copper sulphate only fairly satisfactory. Wells, when treated, appeared to improve for short periods after treatment but water in reservoirs never became entirely clear or free from bacteria.

In cases observed by the writer chlorine has been successfully used to clean up the wells and water in reservoirs. This does not mean that it can be used

Snow IS FUN for KIDS — But . . .





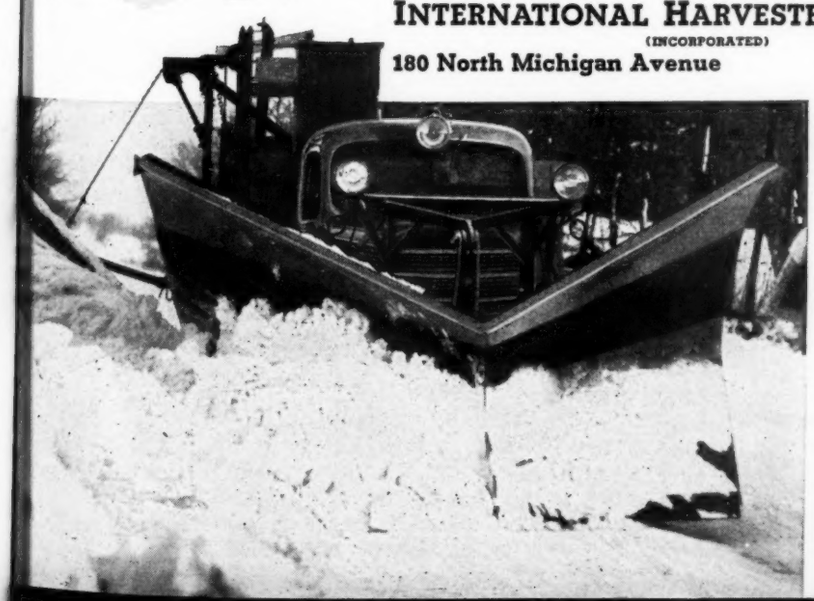
• Snow is serious business for the men who have to keep the streets and highways open. Men and machines must be ready for *instant action* when snow arrives—but men without adequate power are greatly handicapped.

Shake off the shackles of the snow blockade with International Trucks and Tractors. *Here* is *power* that puts snow control right under your thumb; that keeps costs at a minimum; that is backed by after-sale service you can always rely on.

Find out from the nearby International dealer or Company-owned branch how International Trucks and Tractors make a snow-removal program really effective.

Above: The power, traction, and ruggedness of International TracTracTors (crawlers) are highly valued by men who fight snow.

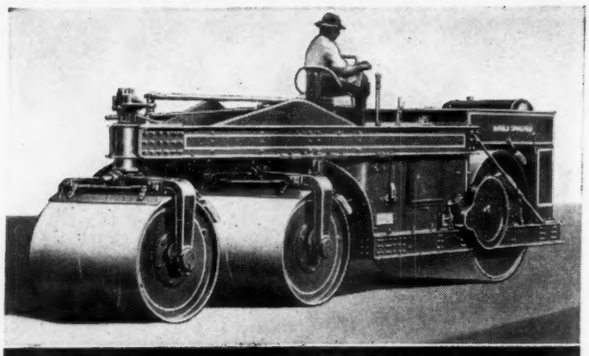
INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
180 North Michigan Avenue **Chicago, Illinois**



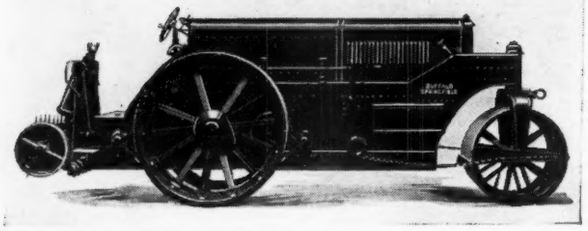
Left: Flexible, high-speed power is delivered by International Trucks on snow-removal work.

Below: The big, new, powerful International TD-18 Diesel TracTracTor will show you new performance and economy in handling snow with heavy-duty crawler tractors.

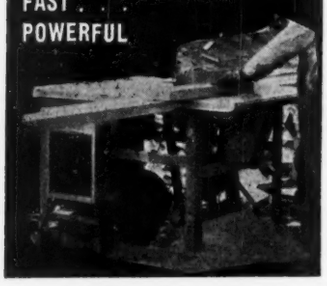
INTERNATIONAL HARVESTER



BUFFALO-SPRINGFIELD
3-AXLE TANDEM — 3-WHEEL AND TANDEM ROLLERS
12 MODELS — 2 to 21 TONS — GASOLINE OR DIESEL POWERED
TRENCH ROLLERS — PORTABLE ROLLERS
THE BUFFALO-SPRINGFIELD ROLLER CO.
SPRINGFIELD, OHIO



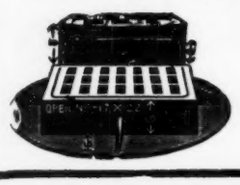
C. H. & E.
SWINGING ARBOR SAW RIG
FAST . . .
POWERFUL



THE C. H. & E. No. 28 Saw Rig is just what you need for rapid cross cut work and heavy ripping up to 6" lumber. Get catalog of complete line. Also send for details of our Pumps, Hoists, 2 & 3 Ton Rollers, Elevators, and Bar Benders and Cutters.

C. H. & E. MFG. CO.
3841 No. Palmer St.
Milwaukee, Wis.

STREET, SEWER AND WATER CASTINGS
Made from wear-resisting chilled iron in various styles, sizes and weights



MANHOLE COVERS, WATER METER COVERS, ADJUSTABLE CURB INLETS, GUTTER CROSSING PLATES, VALVE AND LAMPHOLE COVERS
Write for Catalog and Prices
SOUTH BEND FOUNDRY CO.
Gray Iron and Semi-Steel Castings
SOUTH BEND, IND.

Aeroil TAR KETTLES SAVE 50% ON FUEL
HEAT AND MELT TWICE AS FAST
COMPLETELY INSULATED—HEATED FROM INSIDE!
Latest Development for Heating Tar, Pitch, Asphalt and other Bituminous Materials quickly and economically
AEROIL BURNER CO., INC.
BOX 509, WEST NEW YORK, N. J.
Branches: Chicago — San Francisco — Dallas
FREE
SEND FOR 12 PAGE CATALOG
182W

When writing, we will appreciate you mentioning PUBLIC WORKS.

successfully in all cases. Complaints are probable if the doses are too strong, and if too light they are of no benefit; so it seems necessary to use all the chlorine possible without causing complaint. In one case chlorine was introduced into the affected well, the pump discharge and the reservoir simultaneously and the trouble was cleared up after about ten days' application.

Mr. Brown's experience with ammonia and chlorine was not encouraging but others have reported excellent results. The same danger of complaints of odor and taste exists as with the use of chlorine alone. The most satisfactory method found by Mr. Brown was chlorination at the reservoir inlet followed by dechlorination with sulphur dioxide at the outlet. For this type of treatment, it is necessary that the supply consist of wells pumping into a collecting reservoir. Chlorine is applied to the incoming water in sufficient amount to destroy the iron bacteria, the residual being removed at the outlet by the sulphur dioxide.

One of the effects of iron bacteria growths is decreased main and pipe capacity on account of the growths attaching themselves to surfaces of pipes. Instances have been noted where these growths have become one-half inch in thickness. The writer has noted growths on the outer surface of the bowls and column pipe of a deep-well turbine pump that required the use of wire brushes and a sand blast to remove. The interior of well casings often becomes coated with the growths and mechanical means are necessary to remove them. In reservoirs the growths will often collect in bunches which fasten themselves to the walls or float on the surface as a lot of little islands.

Powerful streams of water will remove the growths from most surfaces, and flushing will get rid of all loosely attached growths in mains. Main cleaning by mechanical means and sterilization should follow. Oftentimes it is necessary to clean even the service lines.

In Des Moines, Ia., iron bacteria appeared in the infiltration gallery system some years ago, but nothing was done until 1930, since when the water department has made it a practice of introducing a high dosage of chlorine at the upper end of the gallery. This prevents the growth of iron bacteria in large volume, and as the chlorine solution becomes diluted in the lower part of the gallery the rate of flow is rapid enough to prevent the accumulation of growth. The iron bacteria found in the Des Moines galleries included all the higher bacteria named above except Crenothrix. The absence of this was not surprising, in the opinion of W. K. Terry, assistant to the general manager, for Crenothrix occurs more rarely than the other iron bacteria and is usually found only in well water after it has passed through the distribution pipes.

It seems to be the rule for waterworks men generally to refer to all iron thread growths as Crenothrix, while as a matter of fact the iron thread growths are often of the other types. It is being realized that it is necessary to distinguish between the different types on account of the treatment that may follow.

Dosage of 0.5 ppm of chlorine are considered sufficient to kill iron bacteria growths, with heavier applications and flushing where growths have accumulated, such as in wells, reservoirs and pipes. For sulphur bacteria, 1.0 ppm of activated carbon has been found effective.

---

*The above is slightly condensed from The Johnson National Drillers Journal, to which we are indebted for the illustrations.

A 200-Year Road Plan

Under this head "Highways and Bridges," an English good roads paper, describes the history of the improvement (still incomplete) of a stretch of road through Royal Borough, near London, that is interesting—perhaps points a moral. In 1750 a petition was presented to the mayor and burgesses by hucksters, that trade on market days was seriously hampered by fast vehicles and asking that the authorities divert the traffic along other turnpike, "to avoid discomfort, distress and injury to the residents of the said borough and the said hucksters." No action taken.

A.D. 1850. Ditto, ditto in different terms.

A.D. 1900. Through traffic had increased tremendously; many accidents on market days.

A.D. 1920. Ditto. Reams upon reams of paper and festoons of red tape accumulate in county, borough and Whitehall offices.

A.D. 1923. Traffic census figures show 100% increase in through traffic since 1913. Virtual agreement reached betwen national and county exchequers to share cost of a bypass.

Spring, 1924. A right of way obtained for 8½ miles 100 ft. wide—120 acres of beautiful farming country. Work commenced on the bypass and a 1¼ mile spur.

Winter, 1927 (3½ yrs. later). Prime Minister Baldwin and other notables open the bypass to traffic. Loud cheers drown the murmur of criticism from die-hard engineers that a single 30 ft. roadway is dangerous for contemporary traffic, and with rapid growth of transport will soon prove a death trap.

A.D. 1930. Local journalist coins phrase—"Bloody bypass." Serious accidents every day. Traffic increased by 200% since opening. Realtors exploiting desirable sites with no paving assessments.

A.D. 1936-7. Loud protests from Bypass Residents' Association, motoring associations, surviving victims and non-surviving victims' families finally result in widening part only of bypass to 60 ft. and forming dual roadways and cycle tracks. (Cyclists insist on using slow lane and leaving cycle tracks to nursemaids.)

A.D. 1937. As danger to pedestrians crossing has been reduced, half a dozen overhead pedestrian bridges are built. Pedestrians refused to climb and descend 50 steps every time they want to cross the road, preferring to risk their lives. Benevolent authority, insisting on saving the taxpayers from themselves, erects steel fence in the central parkway and both verges.

A.D. 1939. Numerous accidents attract attention to a bend on part of remaining miles of single carriageway. As present restricted road expenditure will not allow contemplation of early decision to start major operation (dual carriageway extension), authority decides to super-elevate single carriageway at this point. Meantime, regular travellers have discovered they can save time by avoiding the main road (bypass) and proceeding via Royal Borough. Royal Borough shopkeepers and stall-holders protest that increased traffic interferes with trade. Authority decides not to proceed with dual carriageways at western end of bypass, but to bypass the bypass with another bypass. Exploiters of potentially enhanced site values feverishly bumping up the prices of sites on projected line of new bypass and remaining sites on old bypass. Local hospitals still encumbered by casualties received daily from remaining single carriageway. Demand for speed limit from bypass residents again becomes articulate.

A.D. 1940. You never can tell, but you can make a jolly good guess, more's the pity.

Get catalog, prices on latest 1940 model, light weight, heavy-duty trailers with sensational new features. Other sizes 3½S to 56S. THE JAEGER MACHINE CO., 400 Dublin Ave., Columbus, Ohio.

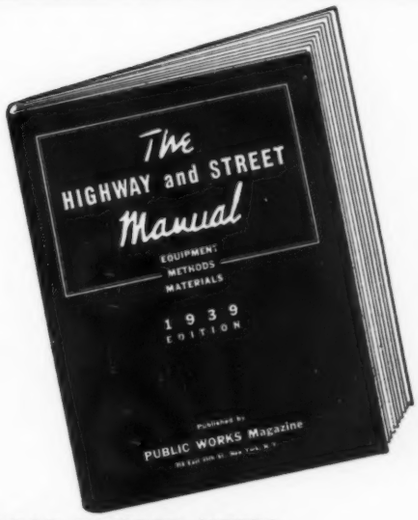
Hotstuf TRADE MARK REG

Contractors Equipment

ASPHALT HEATERS . . . SURFACE HEATERS
PAVING TOOL HEATERS AND TOOLS
HI-SPEED TRAILER TOOL BOXES

Distributors in Principal Cities

MOHAWK ASPHALT HEATER CO.
FRANKFORT NEW YORK



EVERY ROAD BUILDER NEEDS THIS VALUABLE MANUAL

The Highway and Street Manual describes and illustrates all types of equipment and materials used in road, street and highway construction and maintenance;

It illustrates good practices in construction and maintenance;

Keeps the industry informed regarding all new equipment and materials, and their uses;

Provides these important facts in one place, for quick and easy reference, for the whole highway industry.

Emphasizes the advantages resulting from the use of modern equipment and good materials for economical construction and maintenance.

Published by Public Works Magazine
310 East 45th St., New York, N. Y.

When writing, we will appreciate you mentioning PUBLIC WORKS.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

Coating for Steel Pipes

A public works official of Melbourne, Australia, says that coating steel pipe by dipping it and use of asphalt for coating have been abandoned there. Coating 25,000 ft. of 46″ main is now under way, using as primer a solution of pitch in naphtha and applying a coat of enamel by rotating the pipe and moving it past rotary brushes fed with paint for priming and past mechanically controlled pouring pots for internal and external coating, the pipes being spun at 60 to 70 rpm for the former, and slowly for the latter. The pipe is then wrapped with paper felt impregnated with tar. The enamel consists of 55% coal tar pitch, 10% asbestos, 17.5% talc and 17.5% limestone. It does not shatter in cold weather or run in hot.[A108]

Materials for Service Lines

The author believes that there is now no uniformly satisfactory material in common use for service lines, and a new kind of material must and probably will be developed. "Just what this material may be he is not prepared to say, but the development in the field of plastics and synthetic resins indicates that in this direction may lie the answer to the water superintendent's prayer for the perfect service pipe." Material satisfactory for one kind of water may not be for others. For hard waters low in carbon dioxide, lead, galvanized iron, steel and copper are reasonably satisfactory. For soft surface waters, copper is probably the best available. For soft ground waters high in CO_2, cement-lined iron appears best. Lead should not be used with waters high in CO_2.[A111]

Earth Dams

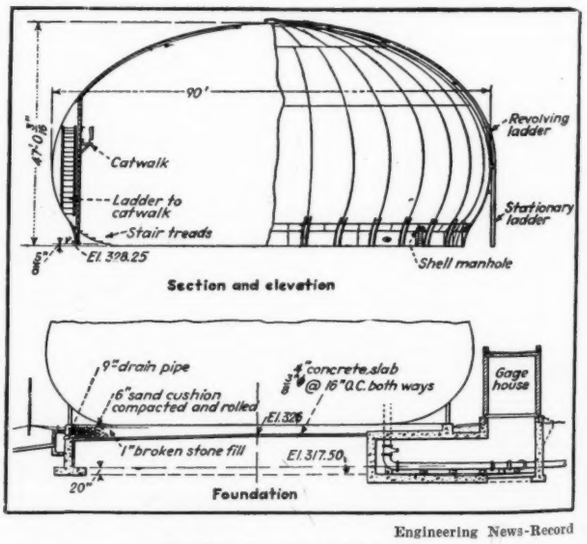
Earth dams, properly designed and constructed, are safe structures; but are known to have defects, but the percentage of serious defects found is negligible. The most serious defect in design is probably inadequate capacity of spillway; one engineer believes that nearly all earth dams are doomed to ultimate washing out by storms greater than provided for. Rolled fill construction of dams is gaining in favor over hydraulic fill, due to increased size, power and speed of mechanical equipment. "Overcompaction is possible and it should be limited to that degree which can be maintained after saturation by the weight of the overlying material."[A113]

Water Department Equipment

The Dept. of Water Supply of Ridgewood, N. J., uses two 5-ton trucks for construction work; also four ½-ton trucks, 3 for meter and service work and one for the general foreman. Other equipment includes a 120-foot air compressor with paving breakers and jack hammers; one 4″ and one 3″ gasoline diaphragm pump; one 1½″ self-priming portable centrifugal pump; a portable generator with floodlights and extension cords; carbide flood lights; electric blinker lights (red) for night protection; pipe thawing generator; Smith tapping machine; electric pipe locators; geophone; meter master.[F67]

Spheroidal Water Tank

The first spheroidal tank for water storage has been erected at Brookline, Mass.; capacity 1.65 mg; 90 ft. maximum diameter (horizontal), 47 ft. high. (Deed restrictions of the property prevented erecting any structure higher than this.) One mg available within head range of 25 ft. Shape approximates that of a rubber balloon filled with water and resting on a flat surface. Center shell is of copper-bearing steel plates butt welded, stiffened by 32 flat rib fins in the form of a segment of a circle set vertical, uniformly spaced around the circumference and welded to the shell, resting on a circular concrete foundation. An outside ladder, curved to fit the tank, can be moved to any position around the tank. A catwalk surrounds the tank on the inside, 22 ft. from the bottom, reached from the bottom by a ladder. The tank is surrounded with large evergreen trees and painted a gray color that blends with the sky.[E35]



Engineering News-Record

Brookline's spheroidal tank

Springfield's Water Filters

At the Lakeside plant of Springfield, Ill., water passes through Spaulding precipitators to four filters with unusual features. The sand has an effective size of 1.0 mm. There are no wash water troughs. Before washing, the water is drained to a few inches below the sand surface and spray from a nozzle under 100 lb. pressure washes the surface. Washwater has a rise of 45″ per min. A filter rate of 200 mgad produces zero turbidity and reduces coliform bacteria from 27 to 0.04 per 100 ml. Hardness is reduced from 168 to 84 ppm. Cost of softening and purification averaged $13.73 per mg in 1938.[E36]

Boston's Concrete Pressure Aqueduct

Boston, Mass., is now constructing an 18-mile pressure aqueduct from Wachusett reservoir to the metropolitan district, 15 miles of which is of

QUINN PIPE FORMS

HAND or WET PROCESS

Make concrete pipe on the job with *Quinn Pipe Forms*. Quinn Pipe Forms can be handled by less experienced labor and produce uniform concrete pipe of highest quality. The recognized standard of all concrete pipe.

HEAVY DUTY CONCRETE PIPE FORMS

Built to give more years of service—sizes for any diameter pipe from 12 to 84 inches—tongue and groove or bell end pipe — any length. Backed by years of service in the hands of contractors, municipal departments and pipe manufacturers.

NEW MEDIUM DUTY CONCRETE PIPE FORMS

Meet the demand for low cost equipment that produces a uniform quality of pipe in smaller amounts. Complete in every way. Stands up on any job. Same sizes as "Heavy Duty," from 12 to 84 inches—any length.

WRITE TODAY

Get compiete information on prices and Special Construction features of Quinn Pipe Forms. Give us size of job for estimate on your pipe form needs.
Also manufacturers of concrete pipe machines for making pipe by machine process.

QUINN WIRE & IRON WORKS
1621 TWELFTH ST., BOONE, IOWA

Essence of

526 WATER WORKS CATALOGS IN 1

If you have 526 Water Works catalogs and data books you have all the current information issued by the manufacturers of water works equipment and materials. But you have only a small part of the practical information supplied by the 1939 Manual of Water Works Equipment and Materials.

The Manual describes and illustrates every type of water works equipment and material, tells how it is best used, gives names of the leading manufacturers. *You can find what you want quickly and easily in the MANUAL.*

THE MANUAL OF WATER WORKS EQUIPMENT AND MATERIALS

Published by PUBLIC WORKS Magazine

INQUIRIES INVITED on all Problems of Water Treatment

We serve as skilled contractors to furnish and install the complete hydraulic and mechanical equipment in all forms of water treatment plants.

ROBERTS FILTER MFG. CO.
640 COLUMBIA AVE. DARBY, PA.

LOOK
What You Save With ARMCO PILING

ARMCO Sheet Piling is supplied in several designs to meet different job requirements. All types are easy to handle and assure proper alignment.

• You can cut job costs with ARMCO Sheet Steel Piling because these sturdy plates can be used again and again. Why buy new piling for every job?

Material costs are lower too. The special corrugated design of ARMCO Sheet Piling assures ample strength without excessive weight. You buy the exact gage that meets your requirements.

Learn more about the money-saving advantages of ARMCO Sheet Steel Piling. Write today for prices and complete information. The American Rolling Mill Company, 372 Curtis Street, Middletown, Ohio.

ARMCO

ARMCO

SHEET STEEL PILING

reinforced concrete Lock-joint pipe, 2 mi. 12.5 ft. diameter, 12.5 mi. 11.5 ft. diameter and 0.5 mi. 7 ft. diameter. The 12.5 ft. is the largest ever made except for the Colorado River aqueduct. It is to operate under heads up to 250 ft. The pipe is being constructed at a plant built for the purpose at Natick, where the 11.5 ft. pipe is cast in 16 ft. lengths, and at Southborough, where the 12.5 ft. pipe is cast in 12 ft. lengths; the steel reinforcement, etc., being made at a plant erected alongside the Natick concrete plant. The pipe (about 50 tons per 16 ft. length) is trucked to the point of laying on low-body trailer trucks. The reinforcement is placed in two spirals, the outer one circular, the inner one elliptical with the minor axis vertical. The concrete is delivered uniformly around the circumference of the pipe, consolidated by 3 outside vibrators and spading from the top; forms removed in 24 hours; steam-cured for 2 days; then turned onto its side (radial jack struts having been inserted) and water-spray cured for 12 days.[E33]

Lead Substitute Joints and Pipe Locators

Ridgewood, N. J., uses a lead substitute for pipe joints and, as they are poor conductors, two lead wedges are driven into all joints before the hemp is placed. This permits the use of an electric pipe locator where necessary.[F67]

Buenos Aires Water Supply

The water purification plant of Buenos Aires is believed to be the largest of its kind in the world. It serves about 2.5 million population; the average consumption is about 240 mgd, maximum 304 mgd. Slow sand filters were used originally, and there is still an area of 284,000 sq. ft. of these, but they are being replaced with rapid sand, of which 132,000 sq. ft. are in use. Double sulphate of aluminum and iron is used as coagulant. The National Administration of Sanitary Works makes its own sulphuric acid and ferric-aluminum sulphate, the latter being carried to the purification in solution through two 12″ wooden pipes.[F77]

Hydrant Inspection in Missouri and Massachusetts

Hydrant inspection in St. Louis and New Bedford are quite similar. Both inspect both Spring and Fall; but while New Bedford flushes both times, St. Louis flushes in the Spring only. The latter apparently paints the hydrants every spring, the former once in 3 or 4 years. St. Louis Fall inspection routine is: Tighten nozzle caps and open hydrant valve, inspect for leaks at nozzles or packing. Close valve, remove all nozzle caps and inspect nozzle threads. Allow barrel to fill with water, close valve and note whether the water escapes through the drain; if not, replace caps and open valve to blow out obstruction. See that hydrant branch gate valve is properly boxed. Make any minor repairs. In the Spring inspection: Replace one nozzle cap with another carrying a pressure gauge; open hydrant valve, record pressure, and inspect nozzles, caps, packing, etc. for leaks. Close valve, remove another cap and open hydrant valve to flush main, reading pressure on gauge meantime. When water runs clear, close valve and make sure that barrel drains. Operate hydrant branch gate valve to make sure it is in good condition. Make repairs necessary. Paint hydrant.[F72]

Cross Connections in Hotels

A joint investigation by the Water and Health Depts. of 651 hotels of San Francisco located 28 direct sewer water department connections, 14 cases of equipment with submerged inlets, 1359 fixtures with submerged inlets, 59 priming lines to pump ejectors, 17 other sources of water, 12 plumbing defects and 12 miscellaneous defects. All these were remedied.[F66]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n.*
August

105. Budget Planning for Municipally Owned Water Works. By J. P. Schwada. Pp. 1263-1270.
106. Planning Water Works Property Development. By C. J. Alfke. Pp. 1271-1278.
107. Labor Relations and the Water Works Field. By L. Wolman. Pp. 1279-1289.
108. Pipe Coating, Electric Drainage and Grounding Practice. By W. A. Johnson. Pp. 1290-1307.
109. Public Relations. By Marion L. Crist. Pp. 1308-1314.
110. Telling the Water Purification Story to a Non-Technical Audience. By M. E. Flentje. Pp. 1315-1322.
111. Applicability of Various Service Line Materials. By E. S. Chase. Pp. 1323-1331.
112. Service Materials. By P. D. Cook. Pp. 1332-1334.
113. Design and Maintenance of Earth Dams. By W. P. Creager. Pp. 1335-1360.
114. The Valuation of Water Works Systems in Canada. By J. C. Keith. Pp. 1361-1378.
115. Water Works Valuation for Rate Making in U. S. by J. P. Wentworth. Pp. 1379-1386.
116. Some Features in Water Coagulation. By H. P. Stockwell. Pp. 1387-1399.
117. Use of Sulfur Compounds for Treatment of Water and Industrial Wastes. By L. V. Carpenter, L. R. Setter and J. J. Coates. Pp. 1400-1416.

D *The Surveyor*
September 1

30. The Place of Water Supplies in Our National Life. (Water for farming districts.) Pp. 236-238.

September 8

31. *p.* Municipal Trading: Water Supply. By N. J. Pugh. Pp. 247-248.
32. *p.* Palestine Rural Water Supplies. By L. T. Colburn. P. 253.

E *Engineering News-Record*
August 31

32. Pressure Aqueduct for Boston. By K. R. Kennison. Pp. 63-65.
33. Making Large Aqueduct Pipe. Pp. 66-69.
34. Story of the Boston Broadside. By M. N. Baker. P. 70.
35. Water Storage in a Spheroidal Tank (Brookline, Mass.). Pp. 71-73.

September 14

36. High Speed Water Purification Plant. By W. W. DeBerard. Pp. 78-79.
37. Welded Iron Waterstop for an Earth Dam. Pp. 90-91.

F *Water Works Engineering*
August 30

65. Pressure Aqueduct to Serve Boston and Vicinity. By K. R. Kennison. Pp. 1100-1102.
66. Ending Cross Connections in San Francisco. By N. A. Eckart. Pp. 1103-1105.
67. Department of Water Supply, Ridgewood, N. J. By J. A. Carr. Pp. 1106-1110.
68. Status of the Water Works Man. By J. A. Jensen, G. A. Sampson and H. Reinhardt. Pp. 1111-1113.
69. It Pays to Test Meters. By A. P. Kuranz. Pp. 1114-1116.
70. Lowering Water Mains at Low Cost. By W. B. Bushway. Pp. 1116, 1147.
71. Treating Alleghany River Water. By N. N. Wolpert. Pp. 1117-1119.
72. Maintenance of Hydants. By W. V. Weir and S. H. Taylor. Pp. 1120-1122, 1156.
73. Slow Sand Filters for Small Town. By P. F. Howard. Pp. 1123-1124.
74. Algae Control at Pasadena. By C. W. Sopp. 1126, 1128, 1130.
75. Efficient Fire Protection. By C. A. Hechmer. Pp. 1139, 1140, 1143.
76. Cleaning Filter Beds with Sulphur Dioxide. By L. V. Carpenter and L. R. Setter. Pp. 1148, 1151.

September 13

77. Water Supply for Buenos Aires. By R. L. Dasso. Pp. 1184-1189.
78. What Thickness for C. I. Pipe? (New law of design.) Pp. 1193-1195, 1212.

G *Water Works & Sewerage*
September

33. Evaluation of the Economic Limits of Meter Maintenance. By D. R. Taylor. Pp. 325-330.
34. New All-Steel Filter Plant, Bethlehem, Pa.). By J. T. Campbell. Pp. 331-333.
35. Detecting Water Waste by Observing Sewer Flow. By D. D. Gross. Pp. 334-336.
36. *p.* Superchlorination as Practiced in North America. By H. A. Faber. Pp. 337-344.
37. Leaks vs. Tax Payers' Dollars. By E. A. Merrithew. Pp. 346-347.
38. De-Watering Mains with Compressed Air. By A. C. King. Pp. 348-349.

J *American City*
September

20. New Water Softening Plant for Shelby, O. By R. F. MacDowell. Pp. 41-43, 63.
21. One Chemical, Three Treatments, at El Segundo, Calif. By L. J. Alexander. Pp. 51-53, 67.
22. Water Rates and Service in 33 Cities. Pp. 81-89.

M *Canadian Engineer*
August 22

6. Water Waste Successfully Eliminated in Owen Sound, Ontario. Pp. 4-5.

September 12

7. Development of Victoria's Municipal Water Works. By G. M. Irwin. Pp. 6-8.

P *Public Works*
September

38. Progress and Developments in Water Purification. Pp. 9-11, 30.
39. Designing a Water Supply System for a Golf Course. P. 20.
40. Recent Developments in Water Purification Equipment. Pp. 32-34.
41. *n.* Copper Sulphate, Fish and Flora. P. 36.

V *Journal, Maine Water Utilities Ass'n.*
September

2. Rate-of-Flow Register. By F. S. Brainard. Pp. 112-117.
3. The Selection of Main Line Meters. By J. Thoreson. Pp. 117-124.

W *Johnson National Drillers Journal*
July-August

2. Geology and the Well Driller. Pp. 1-7.

X *Bulletin, North Dakota Water & Sewage Works Conference*
September

1. Hazen's Municipal Zeolite Softening Plant. By E. B. Hall. Pp. 14-15, 27.
2. Water Tank Inspection. By F. O. Malloy. Pp. 24-25.

The Sewerage Digest

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

Cultures for Initiating Sludge Digestion

In starting a new sludge digestion tank when ripe sludge is not available, cultures of methane-producing organisms would be valuable in greatly reducing the working-in period; also when digestion has been upset by accidental lowering of the pH or introduction of some toxic waste (in which case the disturbing influences must first be corrected). The authors prepared cultures of three different organisms, those fermenting ethyl alcohol, acetate and butyrate respectively. These stimulated gas production much more successfully when the fresh solids had first been liquefied by another group of organisms. Septicization of solids under acid conditions followed by adjustment of pH with buffer salts and then inoculation with these cultures resulted in slower digestion than when the solids were limed during the initial period; better results were obtained by adjustment of pH with ripe sludge liquor, but not so good as when limed solids were similarly inoculated. The ethyl alcohol-fermenting organisms caused less acceleration of gas production than either of the other groups, but best results were obtained by a combination of all three. When 57.1 grams of culture of each of the three types combined with 100 grams of volatile matter were added to limed solids, the total digestion time was reduced 55%. In preparing the cultures, asbestos was added to serve as an inert carrier; after the growth period the liquid was decanted and fresh medium added, and this was repeated, the maximum concentration obtainable taking place after the third transfer.[C58]

Small Plant Without Digestion

The treatment for Fall River, Wis., handles sewage from 3,000 population plus laundry, creamery and cheese factory wastes equivalent to 1,000 pop. Sewage passes through 16-mesh drum screen; trickling filter 25 ft. diameter by 8 ft. deep; settling tank 22 ft. diameter, 7 ft. side depth; 1200 gal. sludge storage tank: chemical tank, 225 gal. capacity; sand bed, ten 10x4.5 ft. areas, housed and heated. The 20,000 gpd of domestic waste flows to a 10,000 gal. pump pit from which it is pumped throughout the 24 hrs. Solids from screen and settling tank are mixed with chemicals for less than a minute and run onto the sand bed, the effluent from which is returned to filter effluent. Sludge on beds can be handled in about 6 hrs., moisture content 80 to 85%, nitrogen content 3½-4% on a dry basis. No odors about the plant—sewage is in it for less than 2 hrs. A mixture of ferric chloride and copper sulfate used as conditioning agent, giving over 95% destruction of bacteria, 98% to 99.9% destruction of coliform. B.O.D. reduction by plant, 64.8 to 87.6%. Filter medium is prefabricated tile; 8-arm distributor with Bink's nozzles, 3 ft. hydraulic head; dosed at 20 mgad with about 1 lb. B.O.D. per sq. ft. per day.[H45]

The Smallest Sludge Processing Plant

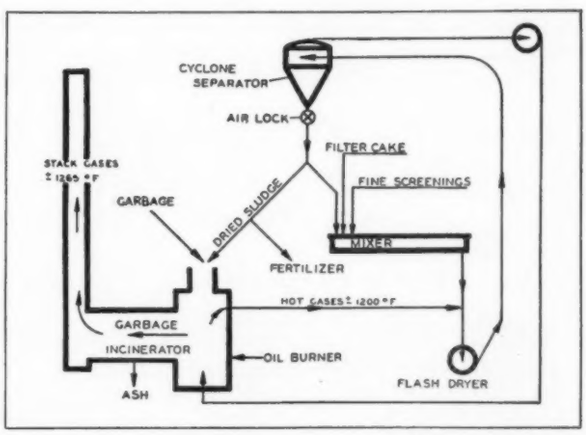
The smallest plant so far constructed for processing sewage sludge is at Tenafly, N. J. Here heat from incineration of municipal refuse is used to flash-dry sludge, which is then burned in the incinerator, thus avoiding the adverse effect of moisture on ignition. The moisture from the flash dryer is introduced into the hot gases from the incinerator. Filter cake and screenings, averaging 86.6% and 91.4% moisture respectively, are mixed with previously dried material so as to get about 45% moisture. This mixture is flash dried to about 10% moisture and part returned for admixture with fresh solids. The plant handles an average of 941 lb. of sludge cake and screenings per hour, of which 115 lb. is dry solids, giving gross evaporation of 826 lb. of water per hour. (Actually an average of about 1,000 lb. per hour is evaporated.) The solids and gases from the flash dryer are separated in a cyclone separator and the gases heat treated for odor elimination.[H46]

Upward Sedimentation of Sludge Effluent

The effluent from centrifugal dewatering of raw sludge at Elizabeth, N. J. is reduced from over 3% solids to less than 0.5% by quiescent flotation. Centrifuge effluent remains quiescent in a tank for 24 hrs. and (because of high grease content and abundance of air bubbles caused by centrifuging) solids rise to the surface and form a mat. Then clarified liquid is drawn off from the bottom and more centrifuge effluent flowed in. After 24 hrs. this is repeated, and a third time in another 24 hrs., enough liquid being applied to float the first day's mat, 3" to 5" thick, above the edge of the tank, when it is skimmed off, the solids content ranging from 10 to 15%. After this the process is continuous. The effluent can, it is said, be returned to incoming sewage without detriment to subsequent treatment.[E22]

Growth-Promoting Substances in Sewage

Ascorbic acid (vitamin C) and Carotene are relatively scarce in raw sewage, but tryptophane, tyrosine, phenyl and naphthyl compounds are relatively abundant. Fresh and septic solids are the best sources of these substances, with fresh activated sludge following. Digestion reduces the quantities, and heat drying or drastic chemical treatment of digested sludge reduces them still further. Oxidation of sewage li-



Municipal Sanitation

Flow diagram of the Tenafly, N. J., treatment plant

quors reduces or destroys the various growth-promoting substances. The relative percentages of the various organic volatile acids change during digestion and the acids are destroyed by oxidation.[C59]

Oxidation of Activated Sludge-Sewage Mixtures

Experiments were conducted to learn why oxygen utilization rate curves produced by different activated sludges when oxidizing the same sewage may be widely dissimilar, and not dependent on the B.O.D. strength of the sewage. It was learned that it is possible to have an activated sludge which is capable of oxidizing only the carbonaceous portion of the sewage, or one with a high proportion of nitrifying organisms, in which case the oxidation of carbon, hydrogen and nitrogen would proceed concurrently if conditions were strictly aerobic. The high initial rate of oxygen utilization by certain mixtures of activated sludge and sewage is due primarily to oxidation of nitrogenous materials, and the duration of the high rate can be prolonged by addition of substances containing readily available oxidizable nitrogen such as urine, urea, ammonium chloride or peptone. The high initial rate in which nitrification is a minor factor was found to be due to oxidation of carbonaceous matter, and glucose was formed to prolong the high rate in proportion to the amount present. Similar effects were not produced by addition of soap or glucose in the former case, nor by soap or peptone in the latter. Duration of the high rate was related to specific components of the sewage in the cases studied rather than to the combined effect of all the components. Sharp breaks in the rate curves usually indicate the completion of the oxidation of one component.[C60]

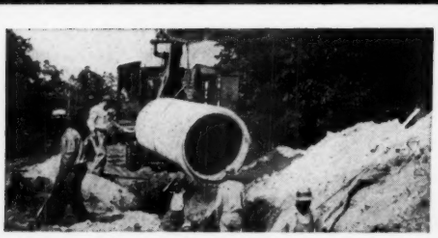
Equipment for Sewer Maintenance

The joint trunk sewer used in common by eleven New Jersey municipalities (The "Joint Meeting") is 54 miles long. For maintenance two trucks are used, one equipped with radio receiving set and each carrying: hydrogen sulfide detector; Wolf safety lamp; combination velocity blower hose mask with safety harnesses; carbon monoxide detector; 2 canister type gas masks; carbon monoxide detector ampoules; 2 pair chippers' goggles; 2½" portable air blower; combustible gas indicator; industrial first aid kit; 4 extra safety belts with ropes attached; salt tablets for use in prevention of heat sickness; 1500-watt portable electric generator and floodlights. Six men are employed; all take a course in first aid and special instruction in use of hose and canister type masks. Compensation insurance is carried and on receiving any injury, even a scratch, the employee must visit a doctor.[G36]

Charging Industries for Treating Liquid Wastes

An equitable basis for charging industries for disposing of their liquid wastes in the public sewage would consider the volume, B.O.D., and suspended solids. Volume increases cost of pumping and size of tanks, etc.; B.O.D. influences cost of treatment; suspended solids increase cost of sludge conditioning, dewatering and disposal. Both B.O.D. and suspended solids are usually higher than in domestic sewage — probably 4 to 6 times as high in many cases. In the Sanitary Dist. of Chicago, packinghouse sewage averages B.O.D. equivalent to 22,250 population per plant; tanneries, 7,550 population per plant; breweries, 7,500; tomato canning, 64,950. Compared in another way, each ton of animals killed is equivalent to 157 population, each ton of paper board to 98 population, and each ton of beer to 149 population.[C64]

LOCK JOINT REINFORCED CONCRETE PIPE



LOCK JOINT PIPE CO., EST. 1905 Ampere, N. J.
PRESSURE • SUBAQUEOUS • SEWER • CULVERT

Stop Rust in Steel Tanks ELECTRICALLY with "RUSTOP"

ENDS RUST. Current from special electrodes, in water, loosens and removes all corrosion; prevents further rusting, continuous application.

PREVENTS RUST. No paint state in water. Permanent installation "RUSTOP" service ends any further damage to the interior. Operating cost surprisingly low. No interruptions to service while installing.

Ask for literature; List of Users

Patents Pending

ELECTRO RUSTPROOFING CO.
743 Third National Bank Bldg., Dayton, Ohio

Use PFT Equipment in Your Sewage Treatment Plant

Write for Latest Bulletins

PACIFIC FLUSH TANK COMPANY
Designers & Manufacturers of Sewerage and Sewage Treatment Equipment
4241 RAVENSWOOD AVE. CHICAGO, ILL.
EXCLUSIVELY SINCE 1893
441 LEXINGTON AVE. NEW YORK, N. Y.

Complete equipment for Filtration, Softening and all other kinds of

Water Purification PLANTS

Dry Chemical Feeders
Swimming Pool Filters

Consult us any time—no obligations.

E. W. BACHARACH & CO.
Rialto Bldg., Kansas City, Mo.

When you need special information—consult the *classified* READER'S SERVICE DEPT., pages 55 to 58

Inspecting Trunk Sewers

Inspection after spring rains will find sewer cleaner and air fresher; with snow off the ground, manholes are more easily found. Two men always together in the sewer as a precaution. While they are in the sewer the manhole covers are open at both ends of the stretch they are in. Look for breaks, spalled or loose bricks or liners, cracks, loose or softened mortar, condition of previous repairs, shape of section, functioning of drop connections, and excessive deposits on the bottom. When you get out, call up your home to have a bath ready.[X10]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

C *Sewage Works Journal*
July

58. Digestion of Sewage Solids by the Addition of Enriched Cultures of Methane-Producing Organisms. By H. Heukelekian and B. Heineman. Pp. 571-586.
59. Growth-Promoting Substances in Sewage and Sludge. By W. Rudolfs and B. Heineman. Pp. 587-594.
60. Activated Sludge Oxidations. By C. N. Sawyer. Pp. 595-606.
61. The Detroit Sewage Disposal Project. By G. R. Thompson, W. C. Rudd and A. B. Morrill. Pp. 607-623.
62. Status of Sewage Treatment in the Connecticut River Valley. By C. I. Sterling, Jr. Pp. 624-635.
63. Observations on Operation of Institutional Sewage Treatment Plants. By J. H. L. Giles, Pp. 636-645.
64. The Disposal of Industrial Wastes. By F. W. Mohlman. Pp. 646-656.
65. The Treatment of Textile Wastes. By R. S. Weston. Pp. 657-674.
66. The Wasco, Calif., Treatment Plant. By T. Mathews. Pp. 675-677.
67. The Visalia, Calif., Treatment Plant. By N. A. Huth. Pp. 677-679.
68. The Delano, Calif., Treatment Plant. By G. Johnson. Pp. 680-683.
69. The Tehachapi, Calif., Treatment Plant. By C. S. Chitwood. Pp. 683-685.
70. Sewage Works Improvements for the City of Bakersfield, Calif. By J. Holfelder. Pp. 685-689.
71. Sewage Treatment Operation Costs. From "The Digester." Pp. 690-693.
72. Operating Report, Champaign-Urbana Sewage Treatment Works. By C. V. Erickson. Pp. 694-699.
73. Annual Reports. By F. W. Mohlman. Pp. 700-701.

D *The Surveyor*
August 18

43. Sewage Disposal at Darlington. Pp. 179-180.

September 1

44. Sewer Manholes and Chambers: Some Views on Design. By L. B. Escritt. Pp. 223-227.

E *Engineering News-Record*
August 31

20. Test Tube Technique in Sewage Treatment Research. By E. J. Cleary. Pp. 74-75.
21. Garbage Digested with Sludge at Small Treatment Plant (Goshen, N. Y.). P. 76.

September 14

22. Upside-Down Sedimentation Clarifies Centrifuge Effluent. Pp. 83-84.
23. Storage Lake Aides Stream Purification. By G. M. Ridenour. Pp. 91-92.

G *Water Works & Sewerage*
September

34. Sewage Treatment Plant of Lakewood, O. By R. F. MacDowell. Pp. 350-353.
35. Copper and Copper Alloys in Sewage Treatment. By R. S. Burr. Pp. 362-364.
36. Sewer Service and Maintenance. By E. P. Decher. Pp. 365-368.
37. Unique Solution for Grit Chamber Design. (Lakewood, O.) By G. E. Barnes. Pp. 369-373.
38. Sewage Treatment Plant of Olean, N. Y. By J. E. Rehler and N. L. Nussbaumer. Pp. 374-379.

H *Municipal Sanitation*
September

45. High Capacity Filtration Without Sludge Digestion. By H. O. Halvorson and R. L. Smith. Pp. 438-440.
46. Tenafly Refuse Incinerator Flash-Dries and Burns Sludge. By A. R. Smith. Pp. 441-444.
47. Bedfort, O., Builds Modern Sewage Treatment Plant. By R. F. MacDowell. Pp. 445-448.
48. Ground Garbage Digested with Sludge. By H. W. Taylor. Pp. 449-450.
49. Plant and Interceptors Protect Iowa Lakes. Pp. 451-452.

J *American City*
September

15. Collection and Disposal Costs for Milwaukee Garbage. Pp. 47-48.
16. Problems of Sewage Treatment. (Popular explanation). Pp. 54-56.
17. Incineration or Burial — Modern Garbage Disposal. Pp. 77, 79.

P *Public Works*
September

37. San Francisco Eliminates Beach Pollution by Sewage Treatment. By J. J. Casey. Pp. 14-18.
38. Regulations for Use of Sewage for Irrigation. (California). P. 28.
39. Gas Sampling Device for Sanitary Land Fill Investigation. By L. R. Setter. Pp. 45-46.
40. *n.* Sewage Disposal and Garbage Reduction in Indianapolis. Pp. 46-47.
41. Suggestions for Designers of Sewage Plants from Operators of Them. Pp. 56-57.

X *Bulletin, North Dakota Water & Sewage Works Conference*
September

8. First High-Capacity Filter in State (Dickinson). By L. W. Viegel. Pp. 10-12.
9. Waste Treatment Plant Built by Armour & Co. at West Fargo. By L. R. Howson. Pp. 19-22.
10. Trunk Sewer Inspection. By H. A. Swanson. Pp. 28-29.

Chlor-O-Feeders stand rigorous service—the successful operation of hundreds of machines, in housings varying from elaborate heated pump houses down to unprotected underground pits, proves this beyond the shadow of a doubt. But it is obvious that the most dependable chlorination *without interruption* will be had when both machine and operator work in comfortable quarters.

Chlor-O-Heater is now offered to fill the need for a standardized unit for use in chlorinator houses, pump houses, or in any water works or sewage plant enclosure for apparatus whose dependable functioning might be impaired by zero weather.

As illustrated, Chlor-O-Heater consists of a portable heating element; and a thermostat (for wall mounting) which can be set to turn current on-and-off automatically following the whims of the weather! Chlor-O-Heater draws a maximum current of 700 watts (larger sizes upon special order); operates on a.c. or d.c., 110 or 220 volt; and COSTS ONLY $37.00 f.o.b. Providence, complete with full instructions.

Order now — winter's just around the corner! — (It's also a good time to order Chlor-O-Feeders for immediate use or for stand-by service.)

Keeping Up With New Equipment

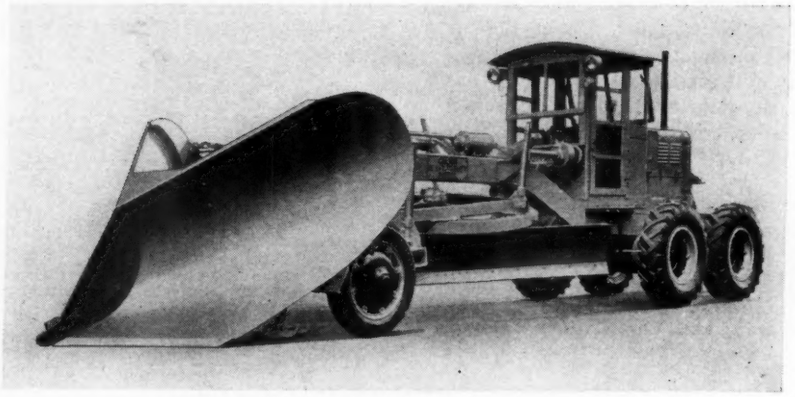
More New Equipment on Pages 53 and 54.

New Galion Heavy Duty Motor Patrol With Snow Plow

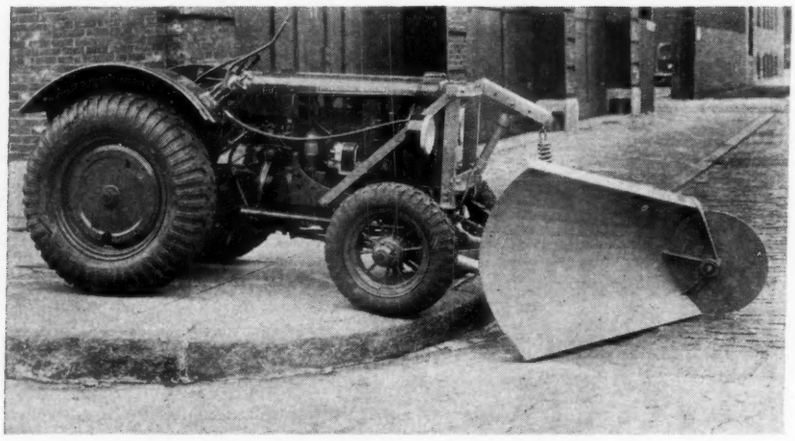
The heavy duty Galion grader and snow plow combination is designed for heavy snow removal and to clear highways and streets quickly and cleanly. The design of this all-welded plow is the secret of its ability to move great quantities of snow with ease.

It can be adjusted by attachment to the scarifier control for dashboard operation, or can be supplied with an independent control where the grader is not equipped with a scarifier, or where the use of the latter is to be retained for combating ice.

The illustration shows the Galion plow attached to a heavy duty motor patrol, the latest unit in the Galion line of motor graders. It is also available for other types of Galion motor graders. Complete information from The Galion Iron Works & Mfg. Co., Galion, Ohio.



Galion heavy duty motor patrol and V-snow plaw

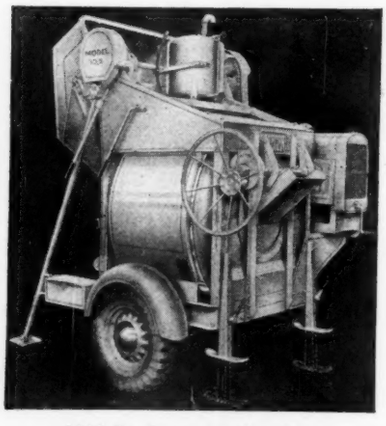


This tractor sidewalk plow is described at the right

Jaeger 1940 Model Concrete Mixers

An automotive type transmission is one of many features of the Jaeger 1940 "Speedline" concrete mixers. It consists of machined, heat treated alloy steel gears and heavy duty ball bearings, fully enclosed from dirt or weather, and running in oil. This improved transmission—said to increase power efficiency by 30% to 40%, increase mixer life, and eliminate most of the usual mechanical noises—is standard on all sizes from 5S up. Pneumatic tires, Timken bearing wheels and spring shock absorbers are furnished for high speed trailing and easier maneuvering of mixers up to 14S size. Two or four-wheel mountings are interchangeable.

Catalog NT40 describes these machines and also an improved end discharge 3½S size equipped with measuring batch hopper. Jaeger Machine Company, Columbus, Ohio.



1940 Jaeger concrete mixer

Tractor Sidewalk Snow Plows

The Anderson Engineering Co., Cambridge, Mass., specialize in sidewalk snow plows which are operated by tractors. A recent order of sidewalk plows by the city of Rochester, N. Y., for use with International wheel tractors, were divided between two different types, one of which has the curb climbing device shown in the accompanying illustration, and the other is a V plow. Attachments are interchangeable.

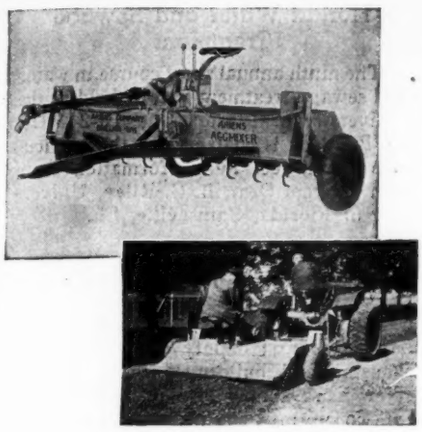
Information in regard to design, sizes and construction data will be furnished by the manufacturers on request.

For Ice and Snow and Sleet—To Remove Winter Hazards

A "saw-tooth" blade for use on graders has been announced by the Shunk Mfg. Co., Bucyrus, Ohio. Fuller information will be given in a later issue, but as a preparation for handling ice, snow and sleet, a brief description is presented here. One trip with this blade, according to the makers, will remove most of the hazards caused by icy streets; two trips will so loosen the snow and ice as to permit a grader with a regular blade to remove it entirely. Further information and folder on request.

V-Type Sno-Plows

This new and complete catalog is devoted primarily to V-type plows for use with motor trucks for fast and efficient snow removal. 28 pps.; beautifully illustrated; and filled with much valuable information for the man charged with snow removal—and also with complete data on Frink plows. Another catalog—The One-Way Blade-Type Snow Plow Bulletin — will be available shortly. Either or both sent on request. Carl H. Frink, Mfr., Clayton, N. Y.



The Ariens Aggmixer at work

The Aggmixer for Mixed-in-Place Construction

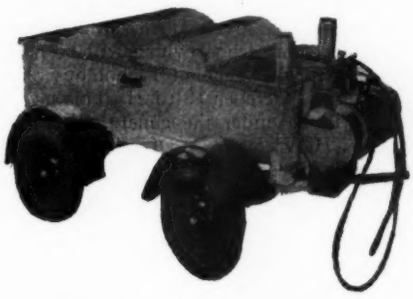
This new roadbuilding unit has two applications in highway construction and maintenance. One is for pulverizing and mixing aggregate on newly scarified roads and preparing them for application of bitumen. The manufacturer claims that this machine will do this work in about half the normal time. The other application is the mixing of bitumen and aggregates. For this work, the Aggmixer is equipped with disks instead of tines, creating a pushing and mixing action. The manufacturer reports that on a recent test on a 1-mile section of road, this machine in connection with two graders saved 15 machine hours of grader operation time.

The Aggmixer must be used with graders, as it does not displace soil laterally, which must be done by graders or other equipment. The primary use of this machine is for speeding up grader operation and reducing grader hours required. Full information from the Ariens Co., Brillion, Wisconsin.

Aeroil 300-Gallon Heet-Master Road Building Kettle

The new Aeroil 9TP Heet-Master tar and asphalt melting kettle provides a new way to heat tar, pitch and asphalt. The heat is placed in the materials instead of under them, through the medium of an immersed double return heating system. The burner is placed in the kettle itself, leaving no gap between burner and kettle. The entire kettle shell is efficiently insulated and a new internal opening (no freeze) draw-off cock is featured.

Originally units up to 165 gallon capacity were furnished but the 9TP has been added. This will melt and heat to proper temperature 32 drums (1600 gallons) of road asphalt in an 8-hour day, equalling the output of an ordinary 500 or 600 gallon kettle, according to the manufacturer.



300-gallon road building kettle

The 9TP Heet-Master is equipped with two removable heating units and two burners, fuel tank capacity is 30 gallons; two-barrel compartments; the kettle rides on pneumatic tires, and will turn in a narrow street. It can be equipped quickly with barrel hoist and power or hand spray as desired. Complete catalog No. 182P will be sent upon request. Aeroil Burner Co., West New York, N. J.

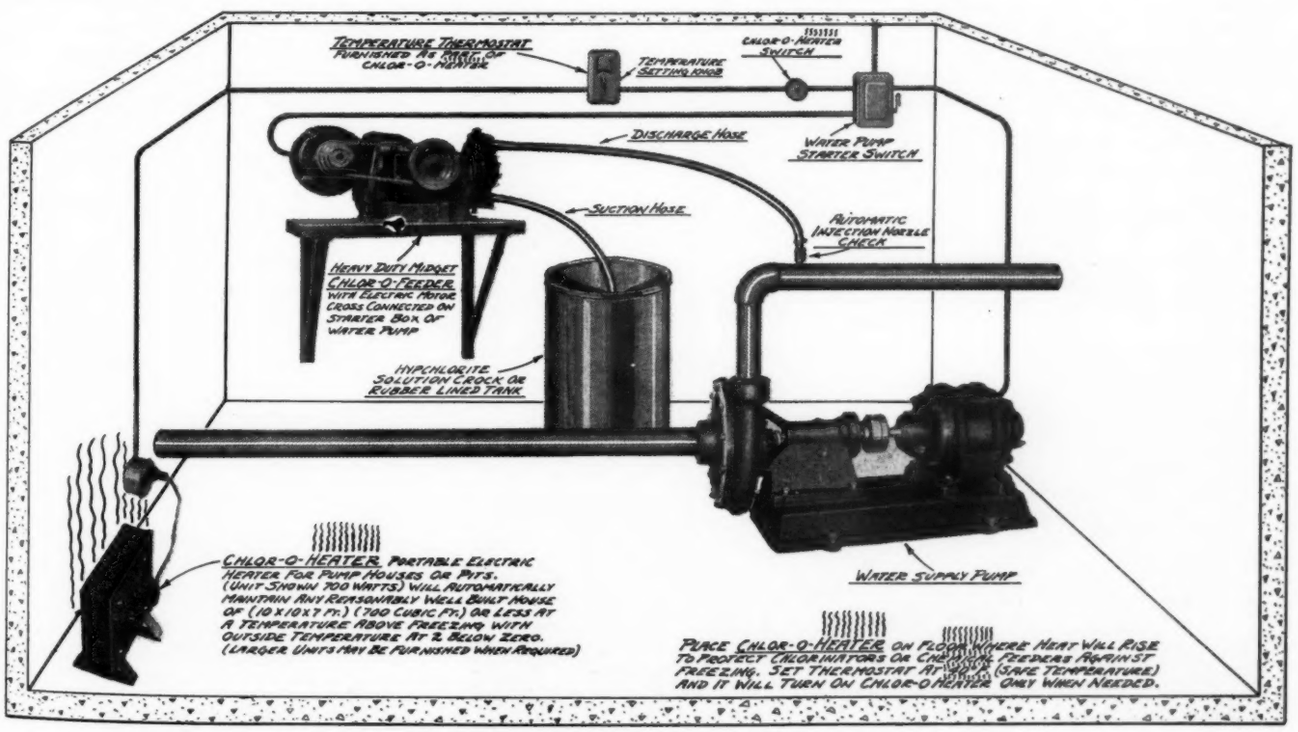
Snow Fighters

The usual excellent Caterpillar booklet and super-excellent pictures showing the applications of Caterpillar equipment to snow fighting work. Caterpillar Tractor Co., Peoria, Ill.

Chlorinators Must Be Kept Warm

The reliability of chlorine application apparatus is appreciated by most engineers and operators. It doesn't take much care or attention to insure chlorination day in and day out over the years. But when cold weather comes, the chlorinator room must be kept above about 50°F, or there may be trouble. Proportioneers have developed a simple electrical heating unit for just this purpose. For a room with 700 cubic feet of air space, a heater having an output of 700 watts will normally be sufficient. A larger room will need a 1200-watt unit. These figures are based on a reasonably well-built enclosure.

To complete the job, a thermostat is supplied, which can be set for the desired temperature, and will turn the heater on and off as necessary to maintain this temperature. Uses 110 or 220-volt AC or DC current. Ask for drawing showing method of installation and a wiring diagram. Proportioneers, 96 Codding St., Providence, R. I.


TEMPERATURE THERMOSTAT FURNISHED AS PART OF CHLOR-O-HEATER
TEMPERATURE SETTING KNOB
CHLOR-O-HEATER SWITCH
DISCHARGE HOSE
WATER PUMP STARTER SWITCH
SUCTION HOSE
AUTOMATIC INJECTION HOSE CHECK
HEAVY DUTY MIDGET CHLOR-O-FEEDER WITH ELECTRIC MOTOR CROSS CONNECTED ON STARTER BOX OF WATER PUMP
HYPOCHLORITE SOLUTION CROCK OR RUBBER LINED TANK
WATER SUPPLY PUMP
CHLOR-O-HEATER PORTABLE ELECTRIC HEATER FOR PUMP HOUSES OR PITS. (UNIT SHOWN 700 WATTS) WILL AUTOMATICALLY MAINTAIN ANY REASONABLY WELL BUILT HOUSE OF (10 X 10 X 7 FT.) (700 CUBIC FT.) OR LESS AT A TEMPERATURE ABOVE FREEZING WITH OUTSIDE TEMPERATURE AT 0 BELOW ZERO. (LARGER UNITS MAY BE FURNISHED WHEN REQUIRED)
PLACE CHLOR-O-HEATER ON FLOOR WHERE HEAT WILL RISE TO PROTECT CHLORINATORS OR CHLORINE FEEDERS AGAINST FREEZING. SET THERMOSTAT AT 60° (SAFE TEMPERATURE) AND IT WILL TURN ON CHLOR-O-HEATER ONLY WHEN NEEDED.

How the Chlor-o-Heater is installed in a chlorinator room

Valves for Water and Sewage Plants

The Hills-McCanna Saunders' patent valve, which operates by means of a resilient diaphragm, is described in a recent bulletin. These valves are suited for ferric chloride service, handling lime and alum solutions, etc. They will not stick, clog nor corrode because of their unusual type of construction. Bulletin on request. Hills-McCanna Co., 2349 Nelson St., Chicago, Ill.

Snell Expands Bacteriological Department

With the addition of new equipment, expansion and modernization, the bacteriological laboratory of Foster D. Snell, Inc., has been enlarged. Samuel S. Epstein is in charge of this department. Paul E. Grotts, formerly of the Kentucky Testing Laboratory, has been added to the staff.

LeTourneau Dedicates Georgia Plant

R. G. LeTourneau is building a plant near Toccoa, Ga., for constructing road-building and dirt-moving equipment. The factory building has already been erected. Construction will soon begin on the erection of steel houses for the employees. An airport near the plant will provide rapid communication. The new plant, which was dedicated at an impressive gathering will manufacture Tournapulls, the most recent addition to the LeTourneau line.

New England Water Works Association

The 58th annual meeting of this association was held in Montreal, Can., Sept. 12 to 15. The state of war no doubt cut down the attendance and it also interfered with the schedule to some extent. Inspection trips to the water works were canceled, and John Bowman, city water engineer of Edinburgh, Scotland, who was scheduled to address the convention could not do so.

Despite these, the welcome on the part of Canadians was warm and the meeting was an excellent one. Percy A. Shaw, superintendent of the Manchester, N. H., water works, was elected the new president, succeeding George A. Sampson. Francis H. Kingsbury, senior sanitary engineer of the Massachusetts Department of Public Health, was elected vice-president. Other officers elected included Karl R. Kennison, chief engineer of the Metropolitan District Water Supply Commission, as director, and Abel Reynolds of the N. E. Water, Light and Power Associates, as treasurer.

The Dexter Brackett Memorial Medal was awarded to Roger W. Esty, superintendent of water works, Danvers, Mass., for his paper on "Relining an Elevated Storage Reservoir with Gunite." Honorable mention went to E. Sherman Chase and Arthur L. Shaw for their paper on "Economics of Water Purification."

Eighth Annual Georgia Water Works Short School

Practical operation of water plants, sewage treatment plants and swimming pools will be given at the 8th annual Georgia short school which will be held at the Georgia School of Technology, Atlanta, Ga., October 18 to 21. This meeting will be under the general direction of W. H. Weir, Asst. Director of Sanitary Engineering, State Department of Health, Atlanta, who will send programs and more detailed information on request. This school is one of the best, and also the best attended, in the country; about two hundred water and sewage plant operators are expected.

Denn M. Burgess, recently elected vice-president and general manager, R. G. LeTourneau, Inc., Peoria, Ill.

The new Frank G. Hough plant at Libertyville, Ill.

Florida Water and Sewage Treatment

The ninth annual short course in water and sewage treatment will be held at the University of Florida Oct. 18-21. Dr. A. P. Black is chairman of the curriculum committee. Full information from him or from Dean B. C. Riley, University of Florida, Gainseville, Fla.

News of Our Readers

Major Albion N. Van Vleck has resigned as first deputy commissioner of housing and buildings of the City of New York and will resume his practice of consulting engineer in association with William Raisch and Associates, 227 Fulton St., N. Y.

V. E. Knight became city engineer of Indianola, Iowa, effective Oct. 1, succeeding S. W. Jorgensen.

Charles A. Criqui, Sr., founder and for 35 years president of Sterling Engine Co., Buffalo, N. Y., is now chairman of the Board of the company. Spencer H. Logan of New York is the new president and Addison F. Vars is executive vice president.

M. H. Morris has been appointed president of Morris Machine Works, Baldwinsville, N. Y., with J. L. Lonergan vice president and general manager, A. G. Forssell second vice president and R. S. Mercer reappointed as secretary and treasurer.

Howard K. Bell, senior member of the firm of Howard K. Bell, consulting engineers, Lexington, Ky., died on September 1, after a short illness. The firm will be continued by his associates, Grant S. Bell and James K. Latham.

J. Henry Crane has been elected president of American Centrifugal Corp., succeeding Stuart Otto. George Henkel, the corporation's chief engineer, has been elected a director.

Recent appointments in the municipal field are:

William Kantola, city engineer, Conneaut, O.

H. M. Shultz, Supt. city waterworks, Huntington, Ind.

John H. Robinson, Supt. Water and Sewers, Concord, Mass.

J. T. Pinkston, Supt. city Waterworks, Meridian, Miss.

I. E. Specht, Supt. Municipal Utilities, Orrville, O.

Tom Quinn, City Engineer, Lima, O.

C. E. Kellog, Supt. of water and sewers, Mt. Morris, N. Y.

Russell Peterson, Supt. of Public Works, Estherville, Ia.

Walter F. Adams, City Engineer, Santa Rosa, Calif.

W. H. Dewey, Supt. city water company, Springfield, Mo.

Earl D. Kramer, Supt. of waterworks, Norwich, Conn.

Wm. M. Price, Supt. of waterworks, Barnesville, O.

Guy J. Edington, Supt. of waterworks, Ionia, Mich.

Use the coupon on Page 55 or send your request direct, mentioning Public Works Magazine.

(Continued from page 55)

Readers' Service Department

Stabilized Roads. This literature contains many charts, tables and useful information and can be obtained by writing The Columbia Alkali Corporation, Barberton, Ohio.

154. "Soil Stabilization with Tarvia"—An illustrated booklet describing the steps in the stabilization of roadway soil with Tarvia will be mailed on request by The Barrett Company, 40 Rector St., New York, N. Y.

155. "Better Bases for Better Roads" is a useful new booklet describing and illustrating the use of calcium chloride stabilized graded aggregate mixtures for pavement bases. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Trailers

170. A fast loading and fast hauling trailer is illustrated and described in a 12-page folder by Meili-Blumberg Corp., New Holstein, Wis. The platform tilts for safe, easy, one-man operation. Initial cost is low, upkeep negligible, capacity up to 10 tons. Write Meili-Blumberg for folder.

Street and Paving Maintenance

Asphalt Heaters

198. Illustrated Bulletins 15 to 20 describe Mohawk Oil Burning Torches; "Hotstuf" Tar and Asphalt Heaters; Portable Trailer Tool Boxes; Pouring Pots and other equipment for street and highway maintenance, roofing, pipe coating, water proofing, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Dust Control

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Issued by Dow Chemical Co., Midland, Mich.

Sweepers, Rotary

300. "Frink Roto-Broom," a 4 page bulletin illustrating and describing a new rotary sweeper by Frink. Attaches to front of and makes a sweeper of any motor truck. Used by street and highway departments, parks, airports, playgrounds, arenas, coliseums, etc., for sweeping dust, dirt, sand gravel, cinders, leaves or snow. Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Snow Fighting

Plows

349. "Frink V Type Sno-Plows" is a 24 page catalog fully illustrating and describing 8 models of V Type Sno-Plows for motor trucks from 1½ up to 10 tons capacity, 16 models of Frink Leveling Wings, the Frink Hand Hydraulic Control and the latest Frink Selective Power Hydraulic Control. Data are given for selecting the proper size V plow and wing for any truck. Issued by Carl H. Frink, Mfr., Clayton, 1000 Islands, N. Y.

Winter Heating Equipment for Contractors

353. A bulletin that shows Concrete Heaters, Coil Water Heaters, Salamanders, Ground Thawers, Steam Thawers and other equipment to keep Winter Construction jobs running at Summer Speed despite snow, frost, sleet, ice or cold. Bulletin issued by the Aeroil Burner Co., Inc., of West New York, N. J. Ask for Catalog 168W.

Sanitary Engineering

Anaylsis of Water

360. "Methods of Analyzing Water for Municipal and Industrial Use," is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., 40 Rector St., New York, N. Y.

Activation and Aeration

375. This concise folder No. 1294 describes "Straightline Aerators" for activated sludge treatment; combines these features: 1, rapid circulation in the tanks; 2, exposure of large surfaces, hastened oxidation and bacteriological growth. Link-Belt Co., 2045 W. Hunting Park Ave., Philadelphia, Pa.

380. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability. 20pp. illustrated. Sent on request to Norton Company, Worcester, Mass.

Aerators for Sewage

381. New 24 page booklet, No. 6571 describes and illustrates the Dorrco Paddle Aerator and also the Turbo-Aerator. Also contains a discussion of the activated sludge method of treatment with much interesting data and illustrations, including a section of "Useful Information." Issued by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Automatic Controls

382. Pressure and liquid levels controls will maintain water level in 50-ft. tank within 1 foot. Send for full information. Electric Controller & Mfg. Co., 2710 East 79th St., Cleveland, O.

Cleaning Sewers

383. Low cost, rapid and complete cleaning of sewers. Booklet on request. Champion Corp., Hammond, Ind.

Cast Iron Sewers

384. Cast Iron Pipe for Sewers. Cast Iron Pipe has beam strength, resistance to crushing stresses and infiltration-proof joints making it highly desirable for flow lines, force mains, submarine lines, outfalls and sewage treatment plants. For specifications write U. S. Pipe and Foundry Company, Burlington, N. J.

Chemical Treatment

385. A handbook on the application of chlorine and iron salts in sewerage treatment. Tech. Publication 177. Wallace & Tiernan Co., Inc., Newark, N. J.

Diesel Engines

386. Write Dept. 118, Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago, Ill., for data on how the installation of F-M diesels has lowered taxes and made it possible for many communitines to pay for their improvements out of municipal power plant earnings.

Feeders, Chlorine, Amonia and Chemical

387. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from %Proportioneers, Inc.% 96 Codding St., Providence, R. I.

388. Chemical Feed Machines. Description, principles of operation; data on installation. E. W. Bacharach & Co., Rialto Building, Kansas City, Mo.

Filter Plant Controllers

389. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Flow Meters

391. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Garbage Incineration

392. Send for full information about the Decarie Suspended Basket-Grate Garbage Incinerator which solves the garbage disposal problem of any city economically and with a minimum of space. Nichols Engineering and Research Corp., 60 Wall Tower, New York, N. Y.

Manhole Covers and Inlets

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Concrete

409. Two excellent booklets, 12 and 16 pps., describe manufacture and installation of reinforced concrete pipe for gravity and pressure lines for sewage and storm drainage. Lock Joint Pipe Co., Ampere, N. J.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints, Sewer

415. How to make a perfect sewer pipe joint—tight, prevents roots entering sewer, keeps lengths perfectly aligned; can be laid with water in trench or pipe. General instructions issued by L. A. Weston, Adams, Mass.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklets. Advertising Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis, Tenn.

Pumping Engines

424. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Run-off and Stream-Flow

426. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

Rustproofing, Electric

427. No painting costs. Current from special electrodes removes all corrosion and prevents rusting. Informative literature on request. Electro Rustproofing Co., 38 N. Jefferson St., Dayton, Ohio.

Screens, Sewage

428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straightline Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago Ill.

Meter Setting and Testing

430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co. Wabash, Ind.

Small Septic Tanks

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets

Readers' Service Department

These helpful booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

(Continued from page 57)

issued by San-Equip Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Drying and Incineration

439. The five basic steps of: sludge preparation; flash drying; incineration; deodorization; and dust collection are explained in a new 24 page booklet, No. 6781 issued by The Dorr Company, 570 Lexington Ave., New York, N. Y., sales representatives for the C-E Raymond system of sludge drying and incineration.

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 216P East 45th St., N. Y.

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

446. 40-page Manual on swimming pools. Includes swimming and pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

447. "Painting Swimming Pools," an interesting booklet by Dr. A. F. Pistor, covers the subject thoroughly, discussing objectively the relative merits of the different types of coatings recommended for that purpose. Write Inertol Co., 401 Broadway, New York, N. Y.

Taste and Odor Control

448. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a booklet issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 77 pages, tables, illustrations and usable data.

Treatment

450. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

453. New booklet (No. 1642) on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures; drawings of installations, sanitary engineering data and design details. Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia.

460. This new 145 page illustrated chemical products book contains 55 pages of Tables, Factors and valuable Reference Data. Issued by General Chemical Co., 40 Rector St., New York, N. Y.

461. Ferrisul for Water and Sewage Treatment. Handy booklet describing Ferrisul and telling how it is used. Merrimac Chemical Div., Everett Station, Boston, Mass.

Valves and Hydrants

470. Complete booklet with much worthwhile water works data describes fully Ludlow hydrants and valves. Sent on request. Ludlow Valve Mfg. Co., Troy, N. Y.

Water Works Operating Practices

490. "Important Factors in Coagulation" is an excellent review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Sewage Plant Operation Control

"Instrumentation of Modern Disposal Methods," a 16-page illustrated bulletin, has been published by The Foxboro Company, Foxboro, Mass. It covers the complete operation of sewage disposal from the raw sewage to the incineration of the processed sludge. A simplified schematic overall plant layout is marked clearly for instrumentation of a "typical" modern sewage disposal plant. The bulletin is liberally illustrated with photographs and diagrams, and describes the Foxboro line of instruments for the particular conditions of any installation. Flow and loss of head, pressure and vacuum, level measurement and control, and temperature measurement are some of the phases of sewage disposal discussed. Bulletin 232, The Foxboro Company, Foxboro, Mass., mentioning PUBLIC WORKS.

Sewage Treatment

A new 16-page illustrated book, No. 1742, has been published by Link-Belt Company, on its Straightline Collector for the continuous removal of sludge from rectangular tanks at sewage treatment and water purification plants. A copy of this new book, containing layout drawings, installation pictures, and capacity tables, may be had by addressing Link-Belt Company, 2045 West Hunting Park Ave., Philadelphia, or the nearest office of the company.

Data on Tires

Produced for the greatest carrying convenience and containing 96 pages, The B. F. Goodrich Company, Akron, O., has just published its 1939 "Operators Handbook." Copies can be obtained upon request to the manufacturer. Ten pages are devoted to tire problems, cord construction and other features of tire building for the commercial field, including a chapter on the need to fit the tire to the job, and another on the functions of the Goodrich tire calculator. Twenty-four pages describe the company's line of truck and bus tires, with complete specifications. Eight pages are devoted to data on the new tractor-grader Super-Traction and other tires used on commercial tractors. Discussion and specifications for industrial tires and the wheels on which the solid tires for this purpose are vulcanized covers 15 pages, while similar information on pneumatic wheelbarrow tires takes up six pages. Load ratings and inflation pressures for tires in commercial service, tables on tires, rims and dual spacing, load and service diagrams, and load analysis occupy six pages, while tables on weights and measures of various commodities and materials take up three pages.

Index to ADVERTISEMENTS

Aeroil Burner Co., Inc. 40
Alvord, Burdick & Howson 51
American Road Builders Assn. 56
Armco Culvert Mfrs. Assn. ....7, 37, 43 & 49
Ashdown, Williams & Co. 51

Bacharach & Co., E. W. 46
Black & Veatch 51
Browne, Floyd G. 51
Buck, Seifert & Jost 51
Buffalo-Springfield Boiler Co. 40

Caird, James M. 51
Calcium Chloride Assn. 3
Cast Iron Pipe Research Assn. 2
C. H. & E. Mfg. Co. 40
Cramer & Sons, Inc., Robert 51

Dorr Co., The 59
Dow, A. W., Inc. 51

Electro Rustproofing Co. 46
Everson Mfg. Co. ..... Front Cover

Frink, Mfr., Carl H. 36

Galion Iron Works & Mfg. Co. 5
General Chemical Co. 4
Gorman-Rupp Co. 37
Greeley & Hansen 51
Green Co., Howard R. 51

Harrub Engineering Co. 51

Industrial Chemical Sales Div. 11
International Harvester Co. 39
International Salt Co. 14

Jaeger Machine Co. ..... 41 & 49

Koehring Company 37

Layne & Bowler, Inc. 12
Link-Belt Co. 50
Lock Joint Pipe Co. 46
Lone Star Cement Corp. 6
Ludlow Valve Mfg. Co. 10

Manual of Sewage Disposal Equipment and Sewer Construction 52
Metcalf & Eddy 51
Mohawk Asphalt Heater Co. 41
Monsanto Chemical Co. 8
Morse Boulger Destructor Co. 8

Nichols Engineering & Research Corp. ..... Back Cover
Norton Company 9

Pacific Flush Tank Co. 46
Pirnie, Malcolm 51
Potter, Alexander 52
Proportioneers, Inc. 47

Quinn Wire & Iron Works 43

Robert & Co. 52
Roberts Filter Mfg. Co. 43
Russell & Axon Cons. Engrs., Inc. 52

Simplex Valve & Meter Co. 8
Snell, Inc., Foster D. 52
Solvay Sales Corp. 10
South Bend Foundry Co. 40

Weston, L. A. 8
Wiedeman & Singleton 52
Wilson Engr. Co. 52